DECEMBER 1986

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ILLUMINATING ENGINEERING

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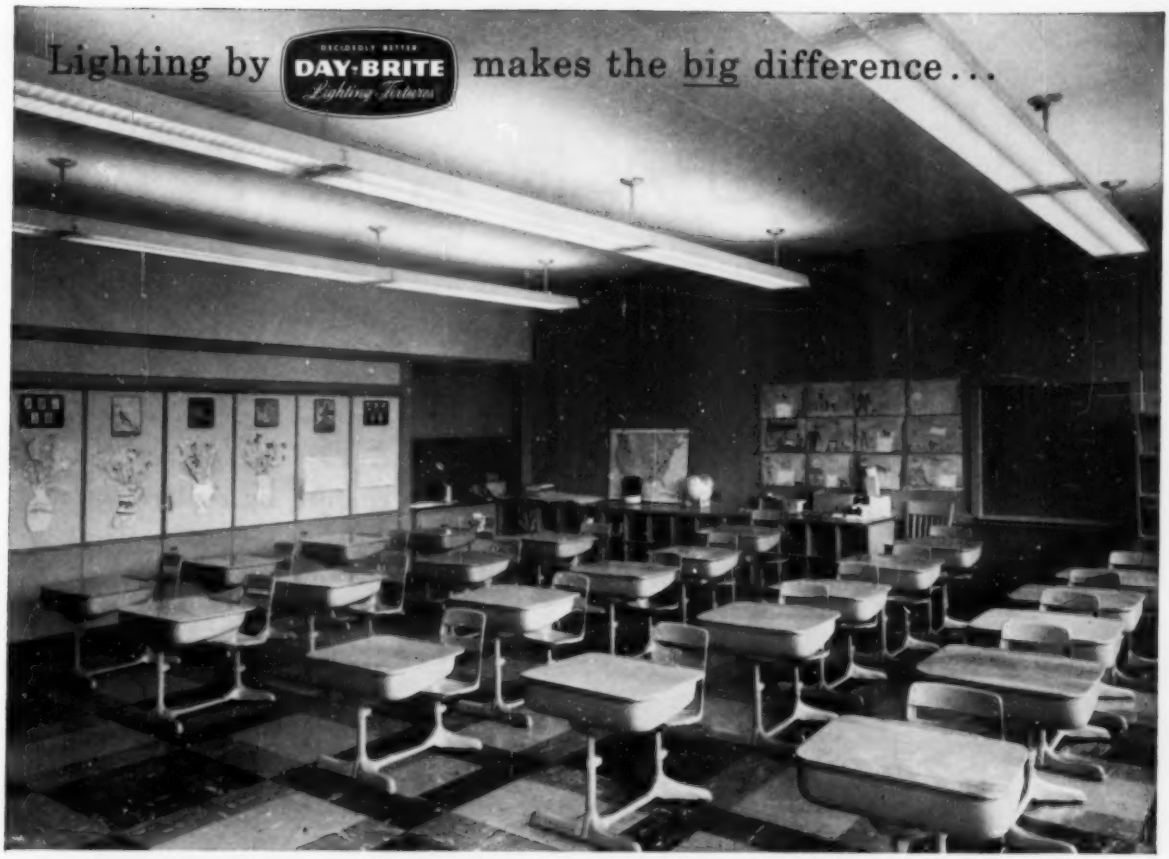

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THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

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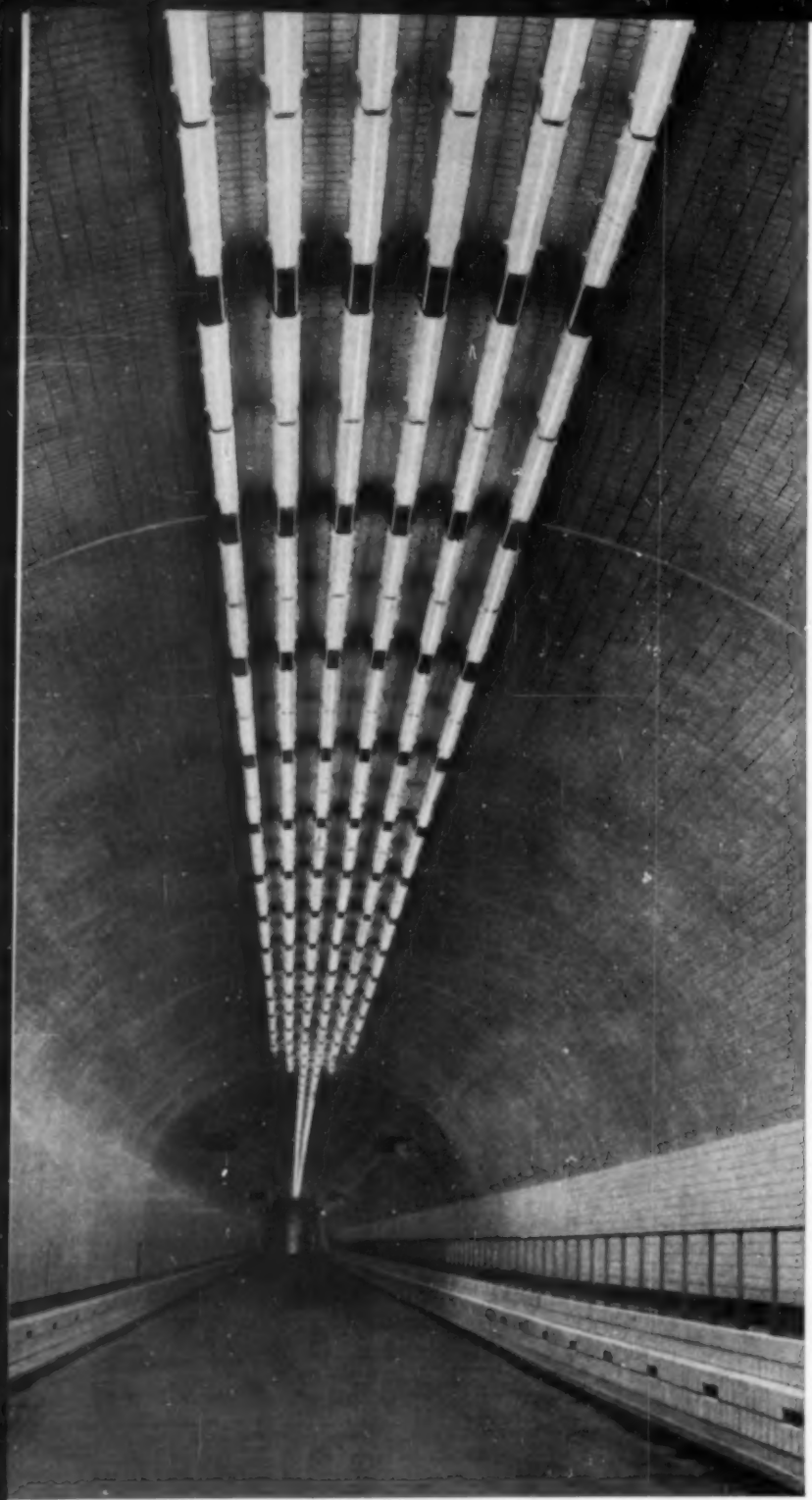

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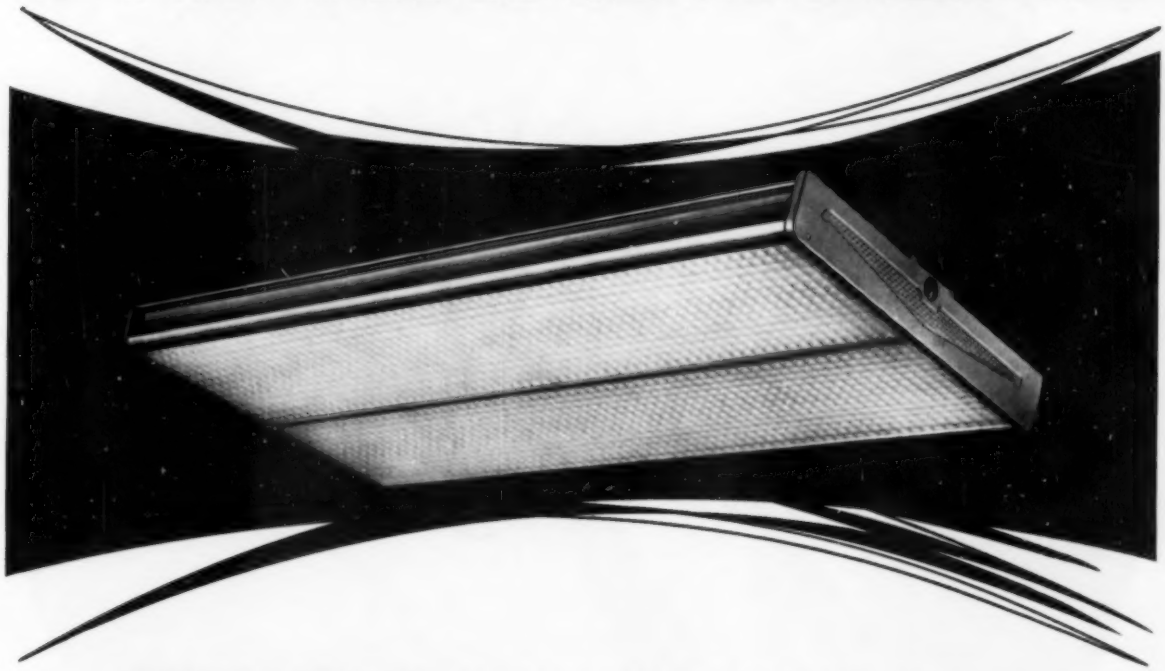

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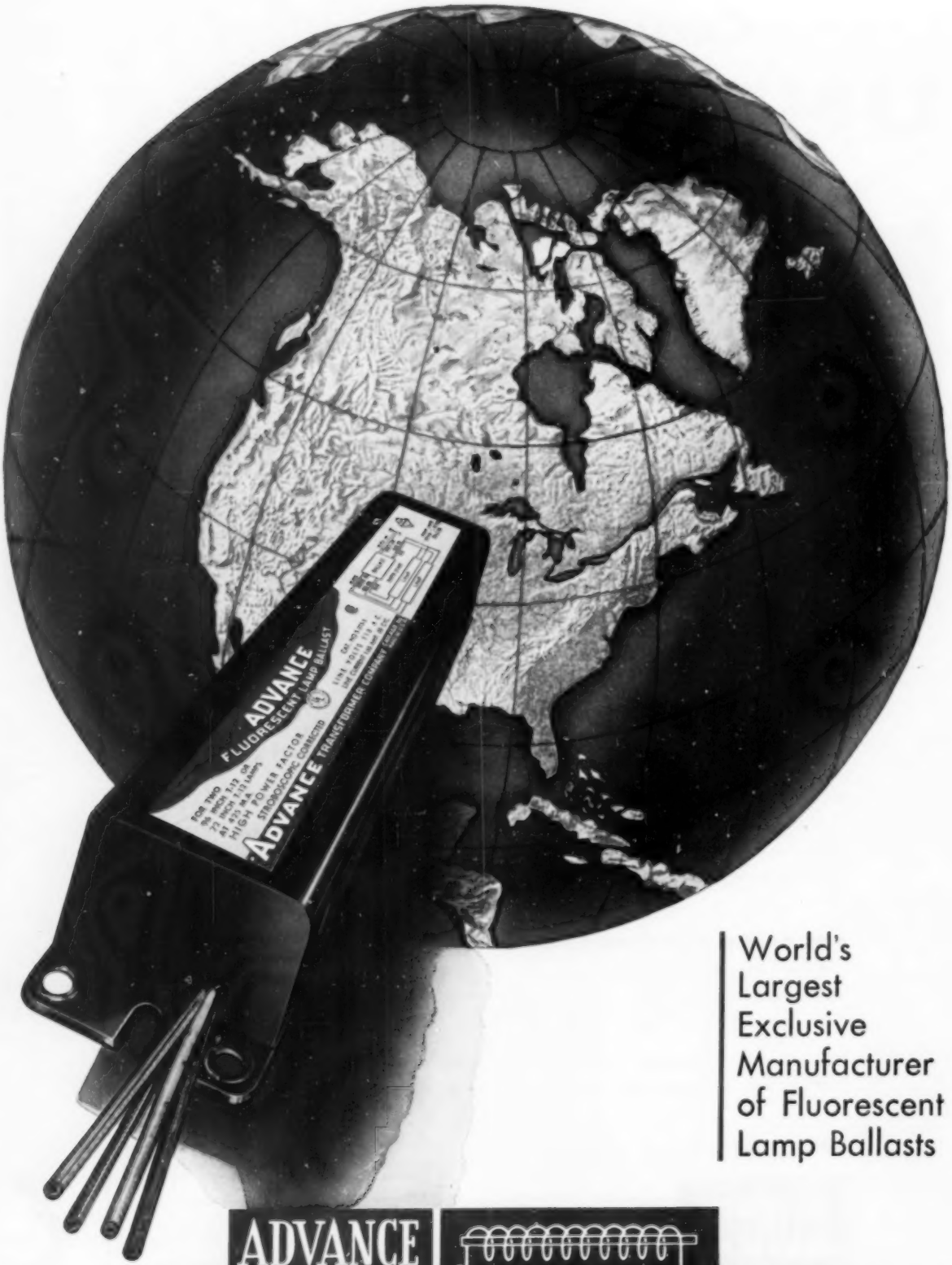

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Lighting Variety in a Modern Building

VARIETY breeds interest — especially in lighting design. Seldom, however, does a design engineer have the opportunity to run the gamut of vast lighting concepts through different applications within a single job. For the Shell Building in New Orleans, Louis N. Goodman and Associates, consulting electrical engineers, did have such a chance. Some areas of their design are more or less routine — some are huge decorative installations requiring a sensitive approach to the aesthetics involved as well as intricate engineering details. Not all of the areas included in the Shell installation are shown on these pages; and the photographs used have been adapted from colored slides. Even so, they afford a glimpse of the variety of lighting techniques applied to achieve the unity of architectural and lighting design for which this building has been so much admired.

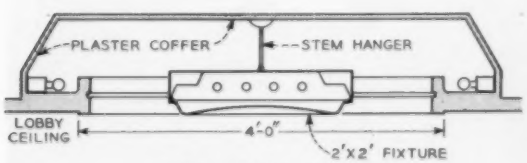
4th PRIZE

Louis N. Goodman
New Orleans Section
Southern Region

Main Entrance Lobby

In the main entrance lobby, surface-mounting type, four 20-watt, fluorescent fixtures were adapted as pendants, by suspending them in coffers which are five feet square. In addition, the coffers are cove-lighted from single 40-watt fluorescent tubes, one on each side. (See drawing.) Side walls and tops of the coffers are canary yellow. The result is a white square of diffused direct light framed by illuminated yellow background.

The cove above the entrance to the adjoining elevator lobby is lighted by single 40-watt fluorescent tubes with ends overlapped.



Coffer and fixture design.

Shell Building New Orleans

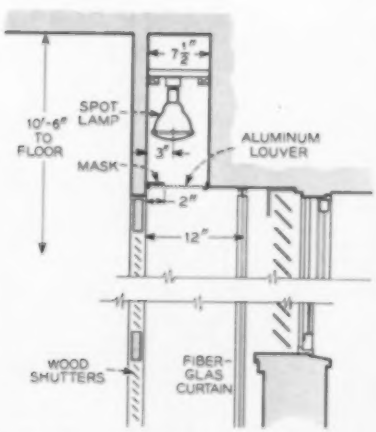
Beauty Parlor

Across an Arcade corridor is this interesting little nook, the Beauty Parlor. The flush ceiling domes are each lighted with four, 100-watt, inside frost incandescent lamps.

For the hair stylists, recessed elliptical reflectors using 150-watt, R-40 flood lamps provide downlight so necessary for hair dressing. Indirect lighting from decorative wall brackets minimizes contrast.

Petroleum Club Lounge

Note judicious use of high-wattage table lamps and lighted windows in the club lounge. Window wells, covered with wood-louvered, New Orleans type folding shutters, are rear-lighted by reflected light from white, Fiber-glas draperies which provide a daylight illusion. The draperies are lighted from PAR-38, 75-watt, spot lamps, 24-inches on centers, in a recess above top of window line. (See drawing.) Note the diffusing louver at the bottom of the recess and the mask to prevent high-lighting the tops of the wood shutters.



Section through window well.

International Room Bar

On the way to the International Room is this bar off the approach corridor. Custom built wall sconces each housing two 75-watt, PAR-38 flood lamps highlight the ceiling over the back bar. Lighted circles in the ceiling over the bar consist of 25-watt, G-25 white coated incandescent lamps with the lower half of bulb exposed below small recessed cans.

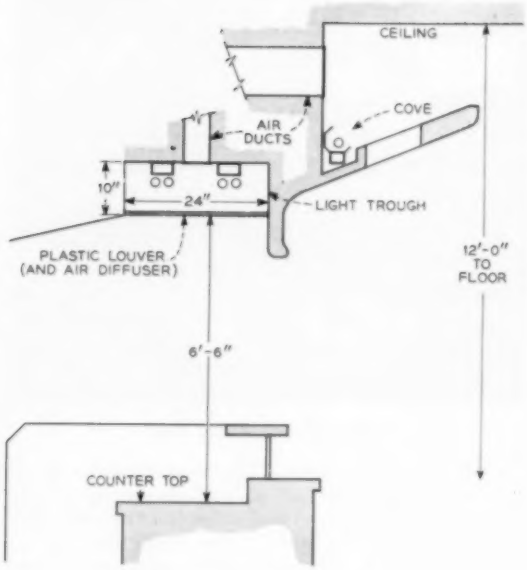
International Room

This beautiful room of the Roosevelt Hotel extension of the Shell Building is a symphony in gold: gold ceiling, gold and white walls, gold chairs, and an eye-catching giant gold American eagle, resplendent under many spotlights. The white domes in the curved ceiling are spun steel custom-designed, five feet in diameter. They are lighted from G-30 250-watt incandescent lamps suspended 24 inches from the dome center inside a hemispherical deflector, gold finished inside and out. The light from the domes is accordingly tinted. Between the rows of domes are rows of recessed PAR-56 300-watt side-prong floods in deep baffled cans, black inside, the flush faces of which had to be tailored to the varying ceiling curvature.

Roosevelt Coffee House

A huge ceiling coffer, below which is hung a custom-built trellis, is a predominant indirect lighting medium for the front half of the serving area. Coffer and trellis are pale pink. Continuous single rows of warm white fluorescent tubes are in the arms of the trellis and contribute direct light through narrow, continuous louvers in the bottoms of the arms.

Shell Building—New Orleans



Section through light trough.

Progressive Bank

Over the tellers' cages an unusual combination of cove lighting, direct lighting and air conditioning diffuser is employed. Note how conditioned air is introduced at the top of the light trough between the two rows of lamps and distributed through the plastic louver trough bottom. (See drawing.) Inside the light cove is painted canary yellow. Light trough is painted white. Both cove and trough are continuous for more than half of the banking space perimeter, about 140 feet. The result is 45 footcandles on the tellers' work tops from the two rows of continuous, two 40-watt fluorescent lamp strips. Strips are staggered with respect to each other.

My Most Interesting Lighting Job Contest

The first, second and third prize-winning entries in the National MMILJ contest were featured in the November issue of I.E., and presented here is the fourth prize installation. Following are those of four of the other National entries, each of which placed first in its Region. If available, the winning installations of the Great Lakes Region and the Northeastern Region will be shown in a forthcoming issue.

St. Joseph's Oratory—In Colored Floodlight

To COUNTLESS thousands of Catholics, both Canadian and American, St. Joseph's Oratory in Montreal, Quebec has great religious significance. It is the evidence of things hoped for — an immense manifestation of things once unseen. The huge Basilica now standing on the northern slopes of Mount Royal in the heart of Montreal was once the dream of Brother Andre, a simple doorkeeper of Notre Dame College opposite. From the small chapel he envisioned, and which now forms the spiritual center of the oratory, has grown this beautiful Basilica, the destination of thousands of pilgrims each year.

To still further enhance its magnificence, both as a landmark and a spiritual symbol, the Catholic Authorities engaged Jean D'Orsay a famous Paris lighting architect to design colored floodlighting for this enormous building. To R. S. Tate, lighting specialist for Canadian General Electric Company, Montreal, befell the task of putting into practice, M. D'Orsay's designs. The architect worked in terms of shadows, color, and textures, doing his planning in watercolor sketches.

One of these beautiful pastels was Mr. Tate's introduction to the lighting problem. His job was to

1. Calculate the number of floodlights.
2. Determine the types.
3. Select the locations.

The magnitude of the problem is difficult to visualize. The copper dome is 120 feet in diameter. The height from the roof to the top of the cross, 200 feet. The height from the roof to the base of the

R. S. Tate
Montreal Section
Canadian Region

Mr. Tate is District Lighting Specialist with the Canadian General Electric Company, Ltd., Montreal, Que.

Mercury floodlights of 400 watts each were used to deliver a bluish color. Bank of six is being mounted on the side of the stairway to illuminate one half the face of the Basilica.

crypt another 200 feet — a total of 400 feet in height.

Because of the immense size of the building, and the requirement of colored effects, the usual incandescent sources with filters were ruled out as being uneconomical.

Three types of light sources provided the tools to achieve the magnificent colored effects of the plans. Sodium floodlights of 140 watts for the golden yellow light with which part of the building was suffused. Mercury floodlights of 400 watts each were used to provide the bluish color. Where white light was required, incandescent floodlights were used.

Application

The small chapel, Brother Andre's first realization, was the natural starting point for the project. Here, three sodium floods light the front and one side. The steeple is lighted with two 300-watt incandescent floodlights. Lighting for the main building (shown in the photograph) was planned by areas, starting with the crypt at the base.

The crypt, 150 feet long and 40 feet high, was a floodlighting project in its own right. Two different colored effects were required, one in blue and one in gold. A third effect, that of pearly white, was obtainable with both.

For the gold effect, ten sodium floods, 15 feet apart are mounted 20 feet out from the crypt. Blue is obtained with five mercury floods mounted on posts 30 feet apart and 40 feet out.

For the front of the Basilica, two banks of six mercury floods mounted on each side of the steps light the main face of the building. Three sodium floods, one behind each column, silhouette these columns and break up the flatness of the mercury-lighted blue. Two sodium floods in the arc of the windows provide the effect of warm light from the interior.

The Oratory, as it stands facing the north on the side of the mountain, can also be viewed from the east and west. Floodlighting on the sides allows viewing from these two other directions, and gives depth and dimension to the building. For these areas: Two banks of six sodium floods on each side of the building. Five 1500-watt incandescent lamps illuminate the step back. One 1500-watt narrow beam flood for each tower.

Only three panels of the huge dome are illuminated; the center panel by three 1000-watt incandescent, or alternately, with three 400-watt mercury. The other two panels, though difficult to light from the orthodox aiming stations, are illuminated by three 1000-watt incandescent narrow beam spotlights from ground level. The windows in the base of the dome are illuminated from inside to neutralize the otherwise floating effect of the floodlighted dome. Crowning the whole effect is the large illuminated cross.

The fortunate choice of discharge lamps for such startling effects is borne out by the amazingly low power consumption. Less than 1 kva is required for the chapel, and approximately 45 kva for the oratory.

Aesthetic Requirements and Technical Considerations Have Been Successfully Integrated in This . . .

Custom-Built Residence

LIGHTING PRINCIPLES teamed with artistic considerations pose many a challenge, but not obstacles. Indeed, their marriage *must* be harmonious when applied in a home. Such harmony, however, does not just happen. In the case of the Philadelphia suburban home shown on the following pages, careful three-way planning involved the architect, the lighting consultant and the owners themselves, for almost every detail of the design. The lighting consultant, no less than the architect, studied the owners' tastes, forms of entertainment and relaxation, habits, prized possessions, and their three school-age children's habits and hobbies. Only after this close acquaintance could the lighting design be integrated so successfully with the aesthetic and functional considerations.

There were, of course, technical problems. How best, for instance, to dramatize prized possessions — a life-size portrait and a large collection of ivories. Drapery track recessed along a 30-foot window wall; the presence of four-foot wide heating ducts; an indoor garden court with a skylight. A flattering "atmosphere" was wanted, presenting an aesthetic challenge. A certain amount of drama was desired — hence the use of both linear and point sources in the living room. Uniqueness was a requirement — hence the twinkling starlight system in the dining room. And for the wiring: this home with its three-phase service entrance and certified wiring has house power with plenty of room for expansion. The lighting both inside and out is conveniently switched locally, and in addition, has two master control points on the low voltage wiring system.

This beautiful home, designed by Frederick Wise, is an excellent example of good contemporary design. Mr. Wise has combined rich and strongly contrasting materials both in the interior and exterior, and so arranged the rooms for the maximum comfort and utility of each member of the family.

The exterior walls of the living and dining room are plate glass from floor to ceiling, draped with nubby beige and white sheer fabric. The free-standing wall dividing the living and dining rooms is covered with a tan textured material. Sliding glass doors separate the dining room and indoor patio. The remaining dining room wall is panelled in natural finish mahogany. A brown-gray stone wall runs the entire width of the house from the entrance through the patio, becoming the fireplace wall in the living room and extending eight feet beyond it.

The ceilings are nine feet high and covered throughout, with the exception of the skylight in the patio, with white textured silk. The patio floor is varying hues of gray flagstone. A white camellia tree, flower pots and ivories on the stone wall, and a small blue tile pool form the decorations of this room. Shoji type laminated rice paper screens are at either end.

The living and dining room have a terrazzo floor, the former covered with a deep pile beige carpet and the latter with an oriental rug.

All rooms in the house were included in the lighting design. Decorative and atmosphere lighting techniques, however, are best demonstrated in the indoor patio, living room and dining room areas where much of the entertaining takes place. This presentation, therefore, is limited to these areas, and to the study and one bedroom.

Elizabeth A. Meehan
Philadelphia Section
East Central Region

Miss Meehan is Residential Lighting Specialist with the Philadelphia Electric Co., Philadelphia, Pa.

Custom-Built Residence

LIVING ROOM — Predominant colors are beige with earth tones. Deluxe warm lamps were used to create a warmth conducive to a feeling of intimacy and friendliness despite the largeness of the room. General illumination is supplied by seven 40-watt fluorescent lamps and five recessed angle-louvered, incandescent units reflecting light from the off-white draperies along the two window walls. Two contrasting types of lighting sources exploit the dramatic differences of linear and round sources, to create an interesting contrast of light pattern on the drapery fabric.

Not shown from this camera angle is a cocktail table highlighted by a pinpoint spot, and fireplace wall dramatized by the same angle-louvered unit used on the draperies. The light from this grazes the face of the fireplace creating strong highlights and deep shadows, thus emphasizing the rich rough texture of the stone.

DINING ROOM — as seen from the indoor patio. Here the atmosphere changes to a more traditional formality which is unified with the living room by a carrying through of the recessed units and continuation of the terrazzo floor. Two adjustable shutter pinpoint spots illuminate the dining table. These units not only set off the table as the major focal point but also highlight the sparkle of the crystal and silver, which throws interesting patterns on the ceiling. Another pinpoint spot enhances the portrait on the panelled wall.

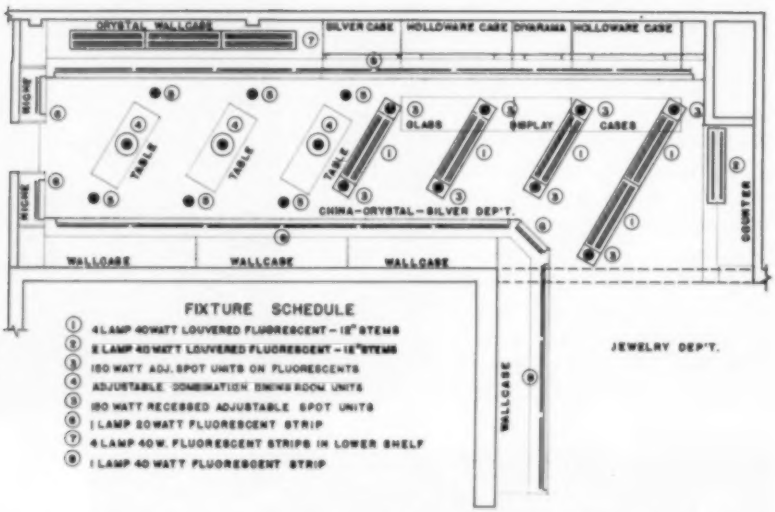
In this ceiling, a twinkling starlight system made up of 10 custom-made pinpoint luminaires creates a pleasant effect. The 6-watt lamps are operated by a blinker system. The on and off pattern is two seconds. One is only pleasantly aware of the effect, not startled by it, and the slow tempo is most conducive to relaxation. The two recessed fixtures center over the table, and having just a slightly larger aperture, are lit all the time and afford a stabilizing axis around which the starlight effect twinkles.

The drapery and patio lighting create a soft luminous surround flattering to the diners, yet not detracting from the highlighted table.

PATIO — During the day this patio is illuminated by natural light from the skylight. At night it is more beautiful and useful still, with cove lighting around the entire perimeter of the skylight cavity. Deluxe cool lamps F30T8 were used here to retain the freshness and openness of daytime and to vitalize the greenery without distorting skin tones. Flower pots and ivory tusks are highlighted by bullet units mounted in the cove and fitted with 150-watt R-40 lamps. The recessed unit mounted above the camellia tree lends the feeling of naturalness to the glossy green foliage of the tree set against the earthy darkness of the flagstone floor. Average general illumination in the patio is 15 footcandles of high quality.

STUDY — Where the owners do their living. In this study, lighting has been designed to provide for reading, television viewing, general conversation, and to dramatize the collection of carved ivories. Lumiline lamps were installed in the cases to enhance the beauty of the ivory carvings as well as to supplement the general illumination. There is local lighting at the built-in desk and bar, and accent lighting at the fireplace. Reading light is provided by two pendent lamps at either end of the sofa. The master bedroom interconnects with the study, and the traveler lamp seen on the left runs over a 10-foot long walnut dresser in the bedroom.

BOY'S BEDROOM — This is the bedroom of one of the sons. Lighting built into the hanging bookcase provides indirect general illumination and direct local lighting at the desk and bed areas. The general lighting is further supplemented by bullet units mounted beside the head of the bed. Recessed bihats illuminate the center floor area.



Harding-Bulloch Jewelry store, Pueblo, Colorado, remodeled from a barber shop.

Jewelry Store Design

FOR APPRAISAL of his wares, attraction to his store, and a pleasing atmosphere, the owner of this Pueblo (Colorado) jewelry store wanted the best that the lighting engineer could devise. A previous experience with relighting a store had convinced him that lighting for merchandising was a sound investment.

High intensity, uniform overall lighting of the area was obtained from five 4-lamp 40-watt fluorescent luminaires on 12-inch stems (on a 12-foot ceiling) and from the general lighting component of the creel-type units in the rear. This part of the system, for appraisal, provides 110 footcandles in the front of the store, and 60 footcandles in the rear. There is no natural light from show windows in this part of the store.

Attraction lighting and essential sparkle is created by a liberal use of 150-watt R-40 spot units and from the downlight component of the creel "pulldown" luminaires. Eight spot units used directly on the fluorescent luminaires, and six recessed adjustable spots provide 260-300 footcandles additional highlighting.

The rear portion of the store is used for the display of table place settings. These are selected by brides-to-be, to make it easy for their friends to choose appropriate wedding gifts. The lighting design here purposely "separates" the two store areas, the rear part having a dining room atmosphere. This is enhanced by the use of three adjustable creel-type units using incandescent lamps centered over the tables, dining-room fashion. Table-place settings are highlighted with an additional

Charles D. Bell

Southern Colorado Chapter

Inter-Mountain Region

Mr. Bell is Supervisor, Lighting Sales and Promotions, Southern Colorado Power Co., Pueblo, Colo.

Area: 13 feet 2 inches by 36 feet long, 12-foot ceiling.

creating sparkle for crystal, silver, china

210 footcandles from the fresnel-lens downlighting of the three creel-type luminaires.

Further attraction is added to this area by lighted wall niches. These two niches are lighted to a 40-60 footcandle range by one single-lamp 20-foot strip with a symmetrical reflector in the top of each niche. Charcoal gray peg board is used in back of the niches.

Wallcases are custom made with stepped glass shelves lighted from built-in canopies. A row of 18 single-lamp 40-watt and two single-lamp 20-watt fluorescent strips behind the shielding boards at the top of each case provides a top to bottom shelf lighting range of 140 to 60 footcandles. In addition to this, the crystal display case incorporates a row of four-lamp 40-watt strips recessed in the bottom shelf and covered with frosted glass. This creates more uniformity in top to bottom shelf lighting, but more important, causes a soft glow from the designs in the cut glass on display, as though from an edge-lighted effect. This case has a top to center shelf lighting range of 56, 38 and 120 *vertical* footcandles respectively.

As with all good lighting design, the room finishes were considered a part of the lighting system, and reflection factors were considered as well as the aesthetics. In this store, the ceiling is a light sea foam green of about 80 per cent reflectance; walls are a light coral only slightly lower; carpet is a medium gray of about 15 per cent RF. Counters and cases are Corina natural blond wood.

Dining-room atmosphere for table setting display is achieved by creel-type units with downlighting, and illuminated niches.

How it was done — inside view of window, at night, from inside the church.

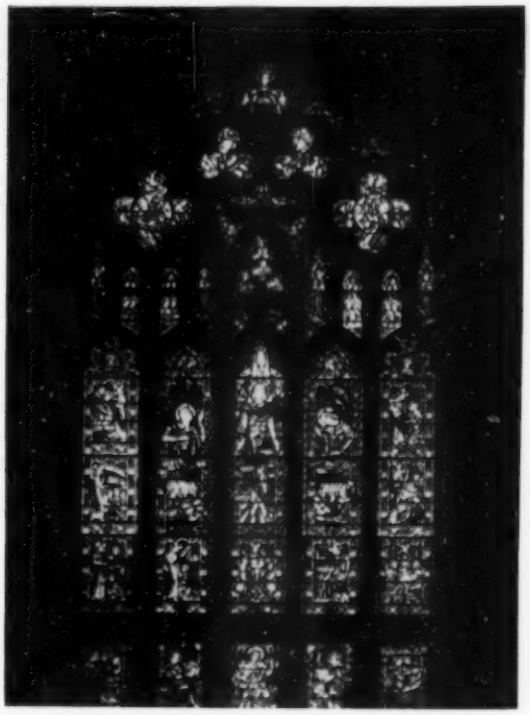
Stained Glass Window—At Night

STAINED GLASS WINDOWS were created, heaven knows how many centuries ago, for the express purpose of creating beauty by means of the light passing through them. However, no light — no beauty. Only a blackened aperture reflecting the darkness of the night. Science and skill of the lighting engineer has retrieved this beautiful effect during the dark hours, in many churches throughout the country.

For the windows of the Highland Park Presbyterian Church in Dallas, Ruth Patterson applied engineering principles, lighting calculations, and a sensitive appreciation of the end effect. The windows themselves were especially beautiful — made by the famous craftsman, Henry Willett of Philadelphia. They were quite large, 12 feet by 23 feet, and faced a busy street. The effect desired, of course, was to light them from within, to be seen by the passerby, rather than from without, to be seen by the congregation.

From within the church the window is visible to the congregation so it was not practical to build a screen to conceal the lighting equipment. The next best solution seemed to be to locate the light sources themselves on the line of sight from the street. This would be on the ceiling of the auditorium. Fortunately, a beam about 12 feet from the window wall was deep enough to conceal the light from the congregation.

From this location the beam spread needed to cover the width of the window was only 32 degrees. Narrow beam floodlights of this magnitude come rather large, and difficult to hide. The at-



How it looks — street view of the illuminated window from outside the church.

that-time new 300-watt PAR56 floodlamp, having a beam spread of 20 degrees by 35 degrees, came to mind. Four of these lamps would give complete coverage. To obtain the light intensity needed for the desired effect, however, it appeared (from comparison with data on other windows) that eight lamps would be required. This would give 110 lumens per square foot.

So far, the design was purely theoretical. Lighting techniques for stained glass vary for each window since the thickness and density of the glass vary. Design must be done by experiment as well as calculation.

Since the density of the glass was an unknown quantity in the calculation, theories were tested by actual experiment. Lamps were to be located 28 feet above the balcony pews in the actual installation; however, trials at this height were not feasible. Instead, two lamps were located on an 8-foot ladder to one side of the window and at the same angle and distance to the side of the window that the final installation would be above it. By walking up the street about half a block in the other direction, the window could be viewed with the lamps back of it along the line of sight. The glass proved to be dense enough to diffuse the source, and the intensities as calculated were satisfactory.

Two banks of four each of the 300-watt PAR56 floodlamps in cast aluminum holders were installed behind the beam. Specifications to the church included disconnect hangers to lower the lamp banks for easy maintenance. However, due to various structural problems, the church elected to build a portable scaffold for maintenance.

A view of the window from inside the church at night illustrates the efficiency of the solution. Notice the cut-off of light just to each side of the window. Practically all of the candlepower of the units is delivered to the window rather than being wasted in lighting the whole end of the auditorium.

Ruth Patterson
Southwestern Section
Southwestern Region

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Characteristics and Applications of Axial Filament Lamps

By C. W. PEARSON
E. A. LINSDAY
R. T. DORSEY

In this paper, a new incandescent lamp design is described which offers to lamp users up to 15% more light without any change in lamp wattage. Its applications in various fields are discussed.

INCANDESCENT lamps have continually been improved in quality since their first introduction. These improvements have taken various directions. For instance, the harshness which was experienced with the early clear bulb lamps has been substantially reduced through the introduction of inside frosted bulbs and various other types of new and improved diffusing coatings. Another direction of improvement is the large variety of lamp types such as reflector lamps, heat lamps, or pressed glass lamps which are particularly suited for specific applications. An additional important area of improvement is the very high degree of precision in manufacturing processes which have been developed over the years, both in the manufacture of the lamp parts and in the fabrication of the lamp itself. This has resulted in users receiving incandescent lamps of greater uniformity and of better quality.

There have also been improvements in light output for a given electrical energy input, which have substantially reduced the overall cost of light. Since the development of ductile tungsten wire, the introduction of the gas filled lamp in 1913 has been the largest step in the increase in lamp efficiency. The increases which gas filling brought about varied with lamp wattage, because of the fact that the filling gas had a greater cooling effect on small filaments than on large ones. For the highest wattage lamps, efficiencies were about doubled, while for low wattage lamps — say 25 watts, there was little or no improvement. At present, lamps above 25 watts are generally gas filled.

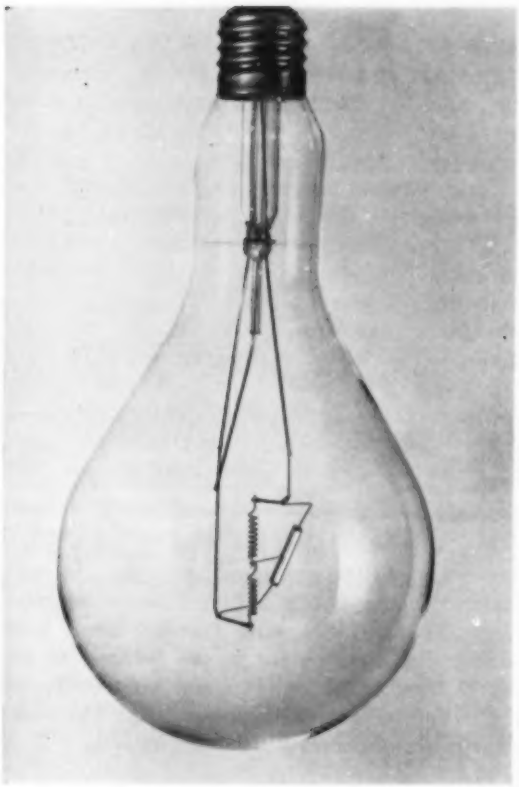
In 1936, the introduction of the first doubly coiled filament in the general service lamp gave another increase in light output over the previous singly coiled, or simple helix, type of filament. This change in design further concentrated the light source and as a result reduced the cooling effect of the filling gas. Since 1936, additional lamp sizes have continually been converted to the doubly coiled CC-6 filament type of construction, until at present there are more lamps of this type used than any other. Approximately six per cent improvement in light output was obtained in the 50- to 200-watt range by this change to the CC-6 filament design.

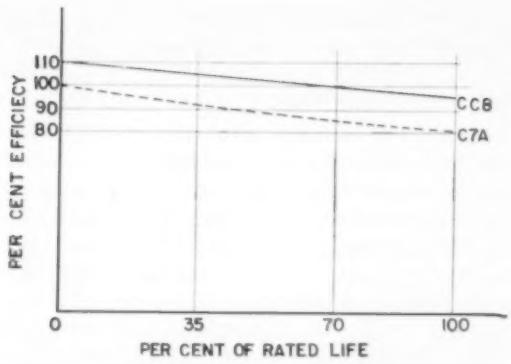
While these short paragraphs do not cover in any adequate way the significance of the improvements in terms of increased value to users, they do indicate some of the directions which have been followed in the past in improving the quality of incandescent lamps.

A New Design Filament Lamp 15% More Light for Same Wattage Input

During this past year, a new lamp design has been made available in the 500-watt, 750-watt, and 1000-watt sizes, which gives 15 per cent more light throughout its life than the 500-watt C-9 and 750- and 1000-watt C7A. This change in design involves the extension of the use of the doubly coiled filament to these higher wattage lamps as well as a new, axial position of the filament. On the surface, this change to a coiled coil, and to an axial, rather than crosswise position, seems simple. Actually, it is a difficult change. Many problems arise in making a satisfactory coiled coil out of relatively heavy wire, and supporting it without introducing additional losses. Further, the axial position introduced entirely new mounting problems. Fig. 1 illustrates this new design. The filament is held by long flexible lead wires. Near the point where the lead wires are clamped around the filament, they

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 17-21, 1956, Boston, Mass. AUTHORS: Large Lamp Department, General Electric Company; C. W. Pearson, Incandescent Lamp Design Engineering; E. A. Linsday and R. T. Dorsey, Application Engineering.





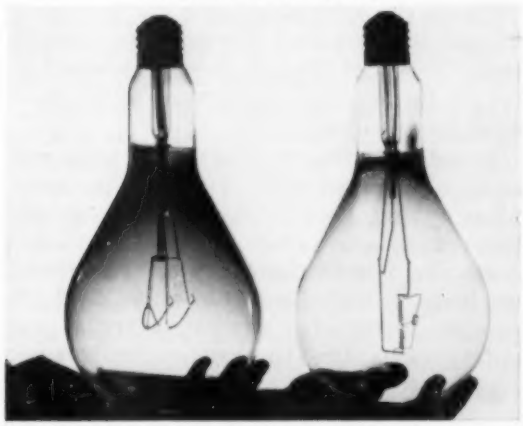


Figure 1. (Above left.) 750-watt lamp — doubly coiled axially mounted filament.

Figure 2. (Upper right.) Lamp efficiency throughout life for lamps with CC-8 and C7A filament constructions.

Figure 3. (Lower right.) Difference in blackening pattern at end of life in C7A lamp (left) and CC-8 lamp (right).

are tied together by a bridge. This bridge serves as an anchor point for the filament center support. The size of the lead wires and manner of bracing have been carefully worked out to provide sufficient flexibility to resist normal shock and vibration and yet be stiff enough to prevent permanent distortion.

The new lamp design offers more light initially, and also has improved maintenance of light output during life, resulting in a 15 per cent increase in mean light output. These relations can be seen in Fig. 2. The reason for this improved maintenance can be noted in Fig. 3. These are 750-watt lamps at the end of life, and they are representative of a large number of lamps which have been tested. It can be seen that the blackening pattern which develops during life is more localized in the case of the doubly coiled, axially mounted, or CC-8 filament lamp, relative to the widespread blackening in the case of the singly coiled, or C7A filament lamp. This accounts for the improved light output maintenance in the CC-8 filament lamp.

The basis for the increased initial light output cannot be shown by any visually obvious means such as in the case of the illustration showing the reason for the improved maintenance. However, improvement is the result of further reductions in the cooling effect of the filling gas, of the higher temperature at which this doubly coiled filament can be operated in its axial position, and of a reduced amount of light directed toward the base.

Of many problems which required solution before these lamps could be introduced, one of the most interesting was related to the tungsten wire itself. This was of particular interest as it was a problem which had also been encountered in the early days of ductile tungsten wire. When, at that time, efforts were made to concentrate filaments in order to reduce the cooling effect of the filling gas, sag of the tungsten was encountered which led to the short circuiting of filament turns. Just as in this work over forty years ago, new procedures in control of tungsten wire and lamp processing had to be incorporated into the production of these new

axial filament lamps in order to avoid sag during lamp life.

Industrial Applications

In order to establish the suitability of the new axial filament design for industrial applications field tests were conducted to determine the following characteristics: (1) lumen maintenance, and (2) life performance in service. In addition, photometric tests were made of the new lamp installed in typical industrial reflectors.

Field Test

The site chosen for the field test was the Locomotive and Car Equipment Works at Erie, Pennsylvania. A plant of this type offered a severe service test for the new lamp which would be typical of many heavy industrial areas.

A total of 172 750-watt axial filament lamps were installed in several areas throughout the plant. Along with the new axial filament lamps, 180 new lamps of the same wattage with the C7A filament design were placed in the same areas to act as control lamps. A typical area is shown in Fig. 4. To provide an even more severe test, twenty lamps of each type were placed on several overhead cranes.

The test of the general lighting fixtures continued until both types of lamps had reached median life — 50 per cent burnouts. The results showed that the same average life was obtained for the two types of lamps under these service conditions.

The median life for the lamps installed on the cranes has not yet been reached after six months' operation. The performance so far for axial filament lamps on the cranes has been equivalent to that of the control lamps with the C7A filament.

By visually examining the lamps of each type at the end of life, the improvement in lumen maintenance was obvious. Fig. 5 shows three lamps of each type which indicate the range (maximum, minimum, and average) of blackening obtained at the end of life(all lamps were burned base up). The top row shows lamps of the new CC-8 filament design and the bottom row shows the control lamps with the C7A filament design. The marked reduction in lamp blackening of the axial filament lamps during the field test further illustrates the fact that the axial filament construction limits most of the lamp blackening to the neck of the bulb where it has less effect on light output resulting in approximately 15 per cent higher mean lumens.

Photometric Data

Fig. 6 shows typical candlepower distribution curves for the 1000-watt clear lamps with the axial filament compared to the C7A filament construction. Generally, the axial filament lamps have slightly less light output in the 0-degree to 30-degree zone, substantially greater light output in the 30-degree to 160-degree zone, and about the same in the 160-degree to 180-degree zone.

Fig. 7 compares the candlepower distribution of the two lamps when placed in a typical porcelain enamel deep bowl reflector. As the curves indicate, the axial filament lamp in this reflector has a greater light output in all zones except in the 0 to 30-degree, in which there is about three per cent less. The overall luminaire efficiency was slightly higher with the CC-8 lamp. Coefficients of utiliza-

Figure 4. One of several industrial areas where 750-watt axial filament lamps were tested for actual service performance.

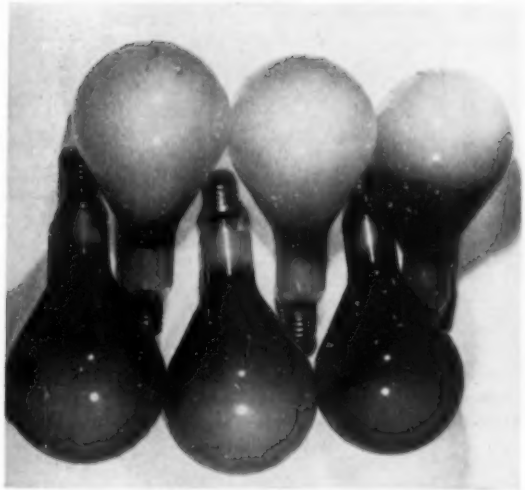


Figure 5. Range (maximum, minimum, and average) of lamp blackening obtained at the end of life for 750-watt inside frosted lamps with the CC-8 and C7A filament construction. The CC-8 lamps are shown in the top row.

tion for the two lamps in this reflector are essentially the same. This results in an initial net gain of approximately 10 per cent in fixture output.

Fig. 8 shows the same comparison for the two lamp types when placed in a semi-diffuse deep aluminum industrial reflector. In this instance, too, the candlepower distribution curves are similar and the coefficients of utilization are essentially the same and the same 10 per cent gain in initial output is realized.

The previous tests were for the 1000-watt PS-52 lamps. However, comparative tests were also made using the 500-watt and 750-watt lamp designs in suitable reflectors. No significant differences could be noted in the candlepower distribution or in the coefficients of utilization. In every case tested, the percentage increase in luminaire light output using the axial filament lamps was as great or greater than the percentage increase in initial bare lamp lumens.

Costs

From a cost standpoint industrial users of incandescent lamps can, for example, change to the new axial filament 1000-watt lamp and obtain a 15 per cent increase in maintained lighting level at no additional cost. On a cost of light basis this extra light is worth approximately $9.00 per luminaire per year. (Based on 1.5¢/kwhr, 4000 burning hours per year, typical maintenance costs.)

Where the existing installation provides adequate illumination, the 15 per cent bonus in light output can be utilized to simplify the maintenance program. The lighting system can be completely changed to the new axial filament lamp and allowed to burn without making replacements until 10 to 15 per cent of the lamps have failed. Then the system is group relamped and the cycle repeated. This system will provide as much or more average illumination as the present system even if each lamp in the installation were relamped immediately on failure.

For new installations, assuming the same operating conditions, the savings in the cost of light including amortized initial costs and annual operating costs are approximately $11.00 per luminaire per year. This saving is equivalent to the entire annual lamp cost per luminaire.

These tests and calculations confirm the suitability of the axial filament lamps for industrial applications. Slight differences in light distribution have little effect; thus full advantage can be taken of the increase in light output.

Commercial Lighting Applications

There is a wide variety of equipment and applications for the new lamp in the store, office, school, and other fields. The results to be expected in diffusing and semi-diffusing reflectors of the type

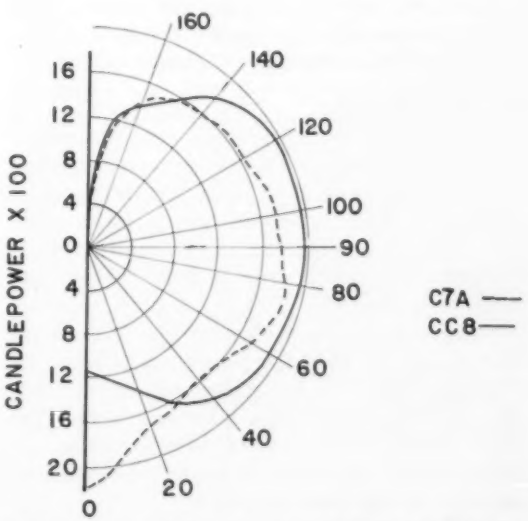


Figure 6. Typical bare lamp candlepower distribution curves for 1000-watt clear lamps with CC-8 and C7A filament construction.

INITIAL ZONAL LUMENS

Zone	CC-8 Lumens	CC-8 % Total	C7A Lumens	C7A % Total
0-30	1,210	5	1,520	7
0-60	5,510	24	5,320	25
0-90	11,700	50	11,200	52
90-180	11,700	50	10,300	48
0-180	23,400	100	21,500	100

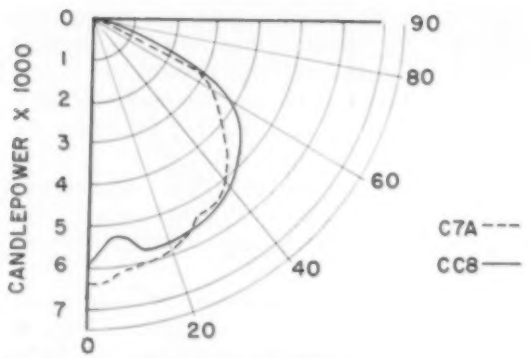


Figure 7. Candlepower distribution curves comparing 1000-watt clear lamps with CC-8 and C7A filament construction in a typical porcelain enamel industrial reflector.

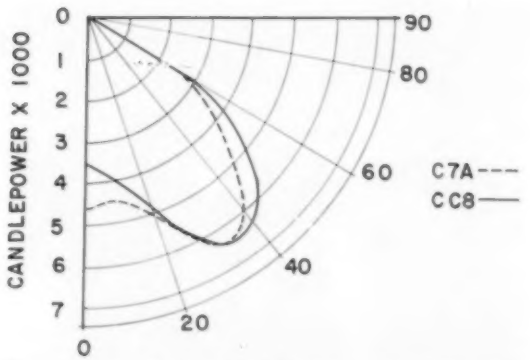


Figure 8. Candlepower distribution curves comparing 1000-watt clear lamps with CC-8 and C7A filament construction in a typical industrial semi-diffuse deep aluminum reflector.

INITIAL ZONAL LUMENS

Zone	CC-8 Lumens	CC-8 % Total	C7A Lumens	C7A % Total
0-30	4,760	20	4,910	23
0-60	15,900	68	15,000	70
0-90	19,600	84	17,860	83

INITIAL ZONAL LUMENS

Zone	CC-8 Lumens	CC-8 % Total	C7A Lumens	C7A % Total
0-30	4,310	18	4,500	21
0-60	16,700	71	15,500	72
0-90	17,900	77	16,300	76

used in commercial lighting are indicated by the industrial units Figs. 7 and 8. Equipment with specular reflectors was expected to be the most critical so a reflector downlight and a show window reflector were chosen as typical examples. Similarly in floodlights, most of the work was done on those with specular reflectors since diffusing reflectors were expected to show minor differences.

Reflector Downlights

Frosted lamps are widely used, and small differences in candlepower distribution are expected. However, even with clear lamps the difference in candlepower between the two filament forms in the unit tested is not radical as shown by Fig. 9. Candlepower straight down is about 20 per cent higher with the CC-8. This is not likely to be objectionable except on a plain surface such as the floor of a lobby when few people are present. At 45 degrees the CC-8 has higher candlepower, but this would be reduced when a louver is used. (The actual reflector used was of mirrored glass, but similar results should be shown by other specular materials of the same contour.)

Table I indicates the substantial gain in lumen output to be expected with the CC-8.

TABLE I — Comparison of 500-Watt Lamps in Reflector Downlight.

Filament	Initial Lamp Lumens	Reflector Efficiency	Relative	Total Initial Lumen Output	Relative
C-9	9900	100%	51.4	100%	5090	100%
CC-8	10,900	110%	52.0	101%	5664	110%

Show Window Reflectors

In the majority of installations, frosted lamps are used, in which case, little difference would be expected between the C-9 and CC-8 filament constructions. An exception would be jewelry windows where the higher brightness reflections of the filament in clear lamps would be an advantage.

In Fig. 10A candlepower distribution curves are shown for the C-9 and CC-8 constructions in clear 500-watt lamps with a wide-spread, angled show windo wreflector. On the display side the curves show differences of about 10 per cent at 0 degree and at 40 to 60 degrees in favor of the CC-8. In the plane parallel to the glass, the CC-8 has slightly more candlepower straight down (Fig. 10B). On

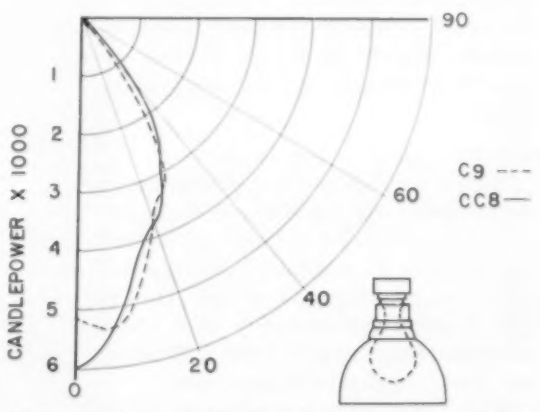
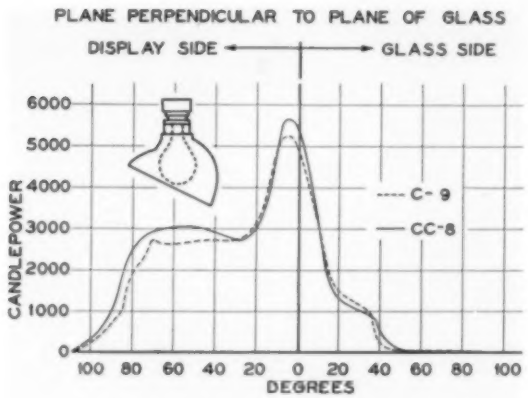
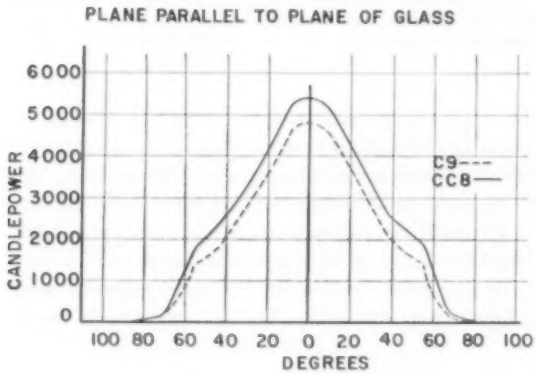


Figure 9. Comparative photometric curves in three planes for a 500-watt angled show window reflector.





the other hand, the spread to 10 per cent of maximum candlepower is about six degrees wider with the CC-8.

Table II gives lumen and efficiency values.

TABLE II — Test in Wide-Spread Angled Show Window Reflector — 500-Watt Clear Lamps.

Filament	Initial Lamp Lumens	Reflector Efficiency Relative		Total Initial Lumen Output Relative	
C-9	9900	100%	67.4	100%	6676	100%
CC-8	10,900	110%	70.1	104%	7640	114%

Investigation of the reasons for the higher efficiency of the CC-8 filament construction in this unit brought out a point that may prove important in many other types of units and the design of new ones. The reflector has a 5-inch diameter opening in the top to accommodate a fastening ring for the socket husk, and to leave room for vent holes. The C-9 filament has a substantial proportion of its lumens directed toward this opening (hence lost) whereas the CC-8 has a small percentage of its lumens in the same zones.

The differences between the two filament forms in clear lamps in the unit tested are small, and for

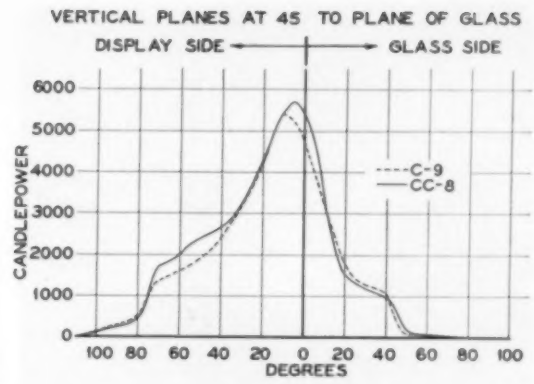


Figure 10. Comparison of the CC-8 and C-9 filament forms in a reflector downlight (without louver).

essentially all show window applications the benefits of higher efficiency and better lumen maintenance of the axial filament will be realized.

Floodlights

Some types of equipment in common use are shown in Fig. 11. In open porcelain reflectors, type A, the lamp usually burns vertically. In enclosed aluminum units of type B, the lamp will be burned at an angle in the great majority of cases. In enclosed aluminum, type C, the lamp is essentially vertical for nearly all applications.

The most critical condition with respect to candlepower distribution is with a specular reflector and clear, lightly stippled or fluted cover glasses. Very little difference is expected with diffusing reflectors, heavily stippled covers, or frosted lamps. An indication of the result is shown by Fig. 8 in which a porcelain reflector was used.

The two photographs in Fig. 12 indicate the difference in beam pattern of a narrow-beam floodlight of type C. The concentration of light near the center of the pattern with the CC-8 will be noted. The curves in Fig. 13 show the effect on beam shape of the two filament forms. As one would expect, the beam spread is narrower with the CC-8 because it is a more concentrated source.

Figure 11. Typical floodlights. A—Porcelain-enamelled open reflector. B—Enclosed aluminum reflector. C—Enclosed aluminum reflector.

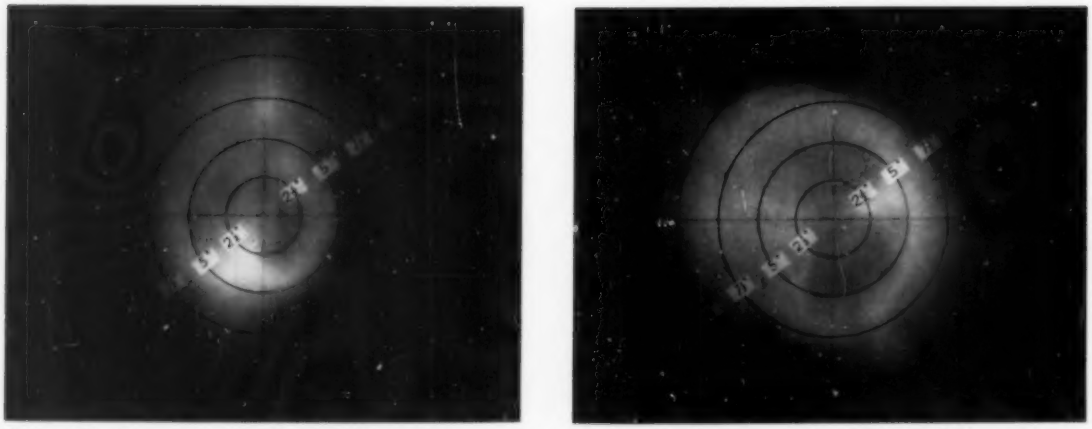


Figure 12. Beam patterns photographed with the same exposure, development, and printing. 1000-watt lamps with CC-8 construction (left) and C7A (right) in narrow-beam floodlight of Type C in Figure 11.

Increased candlepower occurs along the optical axis because the CC-8 filament passes through the focal point of reflector whereas the C7A surrounds it.

Fig. 14 shows a similar comparison in a narrow-beam floodlight of type B (Fig. 11). The greatly increased axial candlepower and reduced overall spread are apparent.

Building floodlighting using wide-beam units will benefit from the lamp. For some existing installations with narrow-beam units the change in beam pattern would be satisfactory. In others, where several beams overlap, the effect is expected to be acceptable. For new installations, the layout can usually be designed to take advantage of the narrower beam pattern provided by the CC-8.

In major sports, narrow and medium beam floods (clear cover, specular reflector) are widely used.

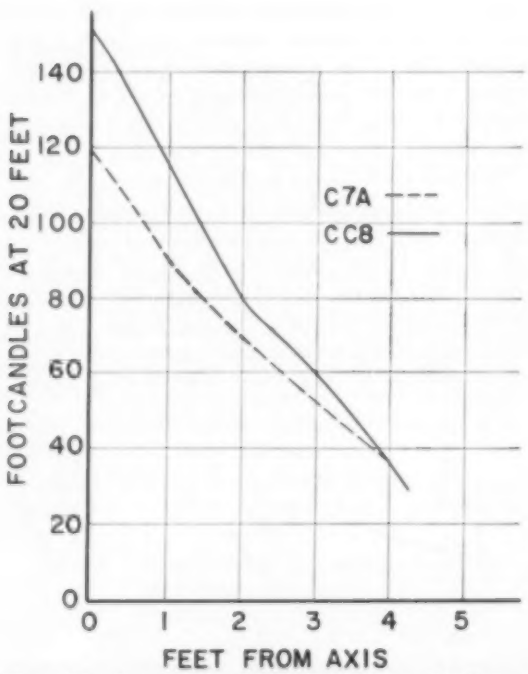


Figure 13. Comparative footcandle patterns of 750-watt lamps in narrow-beam floodlight of Type C in Figure 11.

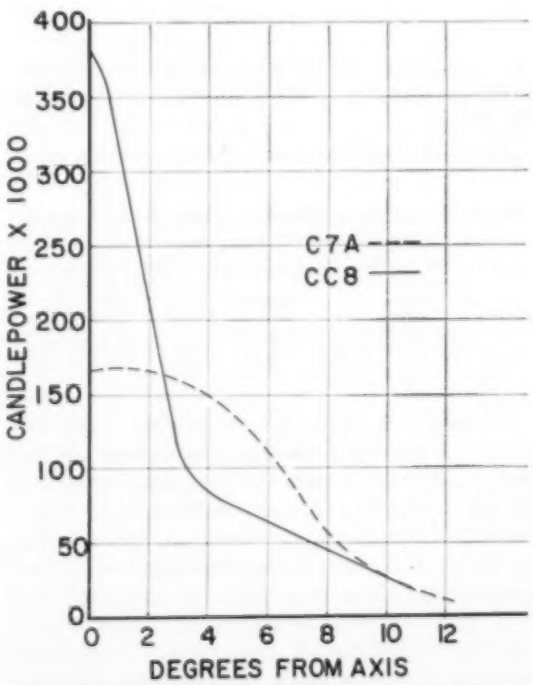


Figure 14. Candlepower distribution curves in narrow-beam floodlight of Type B in Figure 11. (Data by J. S. Franklin, Outdoor Lighting Department, General Electric Company.)

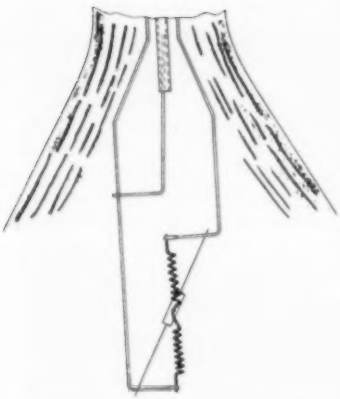


Figure A. Filament construction before burning.

Figure B. Filament construction showing distortion after burning.

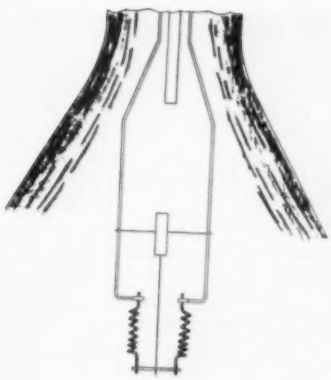


Figure C. Solution to the problem.

Since relatively high levels of illumination are used and many floodlights are installed with good overlap, the CC-8 should be satisfactory and even present some advantages from the standpoint of light distribution. There has been little experience on vibration of towers and poles from wind or other causes. However, based on laboratory tests, satisfactory performance is expected.

Overvoltage burning is standard sports practice for football, baseball, etc. No field experience has been obtained yet, but present indications are that 10 per cent overvoltage will give satisfactory performance.

For railroad yards there should be a definite advantage in the CC-8. Narrow beam equipment is used almost exclusively, and the increased concentration would improve utilization.

For parking lots, outdoor work areas, protective lighting, etc., mostly wide beam types are used.

From the foregoing it can be seen that in many floodlighting installations the CC-8 offers important advantages — either in improved efficiency in service or improved beam pattern or both. In cases where it is not satisfactory, C7A and C-9 constructions are still available.

Summary

An incandescent lamp development has been introduced which offers the user an important increase in efficiency and lumen maintenance. It is apparent that all fields of application will benefit.

In addition, the CC-8 creates new opportunities for more effective reflector design because: (A) It is a more compact filament form; (B) The filament shape can make possible excellent control — particularly in a plane perpendicular to the axis.

DISCUSSION

N. J. Rainone and Bruce Goldsmith:* Messrs. Pearson, Linsday and Dorsey are to be congratulated on their work on axial filament lamps in the larger sizes. The gains in efficiency and lumen maintenance are substantial and the data presented on the use of this source with various reflectors should be very useful.

All burning tests spoken of in this paper are made with 750-watt filaments. Thus, the pictures showing filament distortion are ideal. There is very little sag or twist and the lamp does hold up under vibration.

However, our work on the 1000-watt coil using the construction described in this paper shows that the coil sags and bows on normal burning. The sag and twist become more pronounced on vibration testing. Further, due to the sag and twist, it is difficult to obtain the published gain in efficiency and mean lumens.

Fig. A shows a 1000-watt CC-8 before burning. Note that the coil is free of distortion. Fig. B shows a 1000-watt CC-8 after burning, at 686 hours of its 1000-hour rating. The distortion of the lower coil is quite evident. This is true of all manufacturers' lamps of this construction.

The solution to this problem is the use of two coils in series. Fig. C shows a 1000-watt 2-CC-8 lamp burned 646 hours. Note that the coils are quite free of distortion.

The shorter coil while offering all of the benefits of the single CC-8 filament resists sag and twist. This combined with a more flexible mount construction affords maximum strength under vibration service. Although not yet tested, the double filament should provide even better light distribution from existing fixtures.

J. S. Haney:** The authors are to be commended on their complete and comprehensive report on these new lamps.

I would like to offer comments in reference to the use of these lamps in floodlights. We have tested the new lamps in various floodlights including types illustrated in the paper as A, B and C, Fig. 11. In using the old and new lamps, we have noted differences in the beam pattern which are more pronounced than illustrated in Fig. 12.

*Westinghouse Electric Corp., Lamp Division, Bloomfield, N. J.
**Crouse-Hinds Co., Syracuse, N. Y.

With a type B floodlight with specular reflector and clear cover glass the new filament produces a high candlepower "hot spot" in the center (as illustrated in Fig. 14 in the paper) which is accompanied by an excessive amount of spill light outside the normal beam spread of the unit. One portion of the filament is "ahead" and another portion "behind" the design focal point. With the type C floodlight with specular reflector and clear glass an elongated vertical "hot spot" is produced in the center of the beam.

For applications such as the floodlighting of buildings, signboards and any smaller job with single units or single coverage, the pattern of a single beam alone is important. On some of these installations a change from the old to the new filament might be objectionable. We must consider the many customers who already have floodlighting equipment installed. We are glad to learn that the C-7A and C-9 filaments will still be available and urge that different designations be definitely given to the old and new lamps so that this may be readily recognized by the user.

Information is given on bulb blackening and lumen maintenance based on operation on lamps base up. In floodlighting as with the type B floodlight illustrated the burning position may be all the way from base up to base down. Data on lumen maintenance for other positions (for example for horizontal burning) would be of interest.

We find as noted by the authors that there is no appreciable difference in beam characteristics for floodlights with diffusing aluminum or porcelain reflector or for units with specular reflector which have heavily diffusing cover glass or where frosted lamps are used. It appears, therefore, that in many cases the decided advantage of these new lamps may be enjoyed by the floodlight customer.

C. W. PEARSON, E. A. LINSDAY and R. T. DORSEY:* We wish to thank the discussors for their comments.

As to the sag problem, this is one which we have experienced in some of the 1000-watt lamps in the experimental and first production stages. This is a problem which has previously been encountered with new incandescent lamps of more concentrated filaments. For example, when the 60-watt coiled coil lamp was introduced back in 1936, this same situation developed. This sag condition was corrected in the 60-watt lamps. Similarly, the experience that wire engineers have developed over the years enabled them to promptly correct the sag problem encountered with the coiled coil 1000-watt lamps.

The 2-CC-8 construction, as described by Mr. Goldsmith, was studied in the early development stages and can be expected to be lower in efficiency than the CC-8.

We appreciate the additional information given by Mr. Haney, and agree that there are some installations where the candlepower distribution of the CC-8 in present equipment is not satisfactory. For these the former construction is still available.

Lumen maintenance in positions other than base up is slightly lower, but is better in any position than the C-9 or C-7A construction.

We are particularly pleased that one of the major floodlight manufacturers agrees that in many cases the decided advantages of these new lamps may be enjoyed by the floodlight customer. In addition, as pointed out in the paper, the new construction offers new opportunities for more effective reflector designs.

*Authors.

Decorating for Christmas

Decorative "kissing ring" is made of embroidery hoops wrapped with gold ribbon and studded with sequins. The mistletoe is highlighted by a small bulb concealed in a similarly decorated bullion cube tube. The wiring runs around one of the hoops (under the ribbon) up to the greens and then under the drapery to a baseboard convenience outlet.

Photo and data courtesy of Westinghouse Electric Corp., Lamp Division, Bloomfield, N. J.

INSTALLATION AT JAISSON'S SHOE STORE, BRADDOCK AVE., BRADDOCK, PA.

Lighting a Shoe Store

LIGHTING OBJECTIVE: To provide general and supplementary lighting for displaying and selling shoes and accessories by a lighting system integrated with the ceiling design.

GENERAL INFORMATION: The shoe and accessory sales area shown above measures approximately 14 feet x 68 feet. The ceiling heights and simulated roof truss dimensions are shown in Fig. 3. Colors and reflectances throughout the area are as follows:

	Color	Reflectance
ceiling	black	5%
walls		
above shelves	black	5%
shelves	grey	50%
simulated roof trusses		
(alternately)	pink	60%
	white	75%
	grey	40%
show case trim	blonde wood	60%
floor tile		
light	grey	40%
dark	black	10%
carpet	grey	40%
chairs		
light	ivory	30%
dark	red	15%

(over)

A.I.A. File No. 31

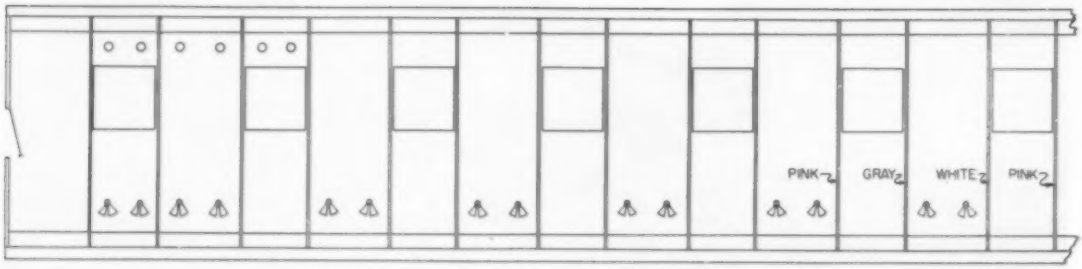


Figure 2. Plan view showing location of lighting equipment.

INSTALLATION: Fig. 2 is a plan view of the shoe and accessory sales area showing the location of all luminaires. The seven suspended fluorescent metal louvered 4 foot x 4 foot units were custom built by Pittsburgh Plated Products Company. Each is equipped with six 40-watt T-12 standard cool white lamps. The six incandescent units over the show cases are Swivelier catalog No. 1809 surface mounted in a metal housing. Each is equipped with one 150-watt R-40 flood lamp. The fourteen incandescent units along the shoe shelves are Swivelier double shade units catalog No. 2 B 79-24 with louvers. Each is equipped with two 150-watt R-40 lamps. The average general horizontal level of illumination is 40 footcandles. Vertical illumination on the shoe shelves 42 inches above the floor is 30 footcandles.

Brightnesses are as follows:

luminaires	
fluorescent at 45°	400 ft-L
incandescent, over show cases, at 45°	800 ft-L
incandescent, at shoe shelves, at 45°	800 ft-L
ceiling	———
simulated roof trusses	
pink	4.5 ft-L
white	5.7 ft-L
grey	3 ft-L
walls	
above shelves	———
shelves	30 ft-L
show case trim	22.8 ft-L
floor tile	
light	14.5 ft-L
dark	3.5 ft-L
carpet	11 ft-L
chairs	
light	12 ft-L
dark	5.5 ft-L

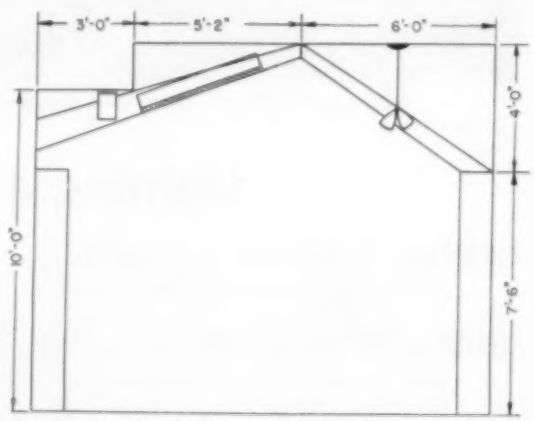


Figure 3. Cross-section.

Lighting designed by Herbert L. Seigle, Designer, 1120 Monongahela Blvd., McKeesport, Pa.; installed by Paul F. Rost, Electrical Contractor, 500 Terrace Road, McKeesport, Pa.

Lighting data submitted by Armand G. Zitelli, Duquesne Light Co., 435 Sixth Ave., Pittsburgh, Pa., as an illustration of good lighting practice and to aid in the design of similar installations.

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Fluorescent Lamp Performance As Affected by Impurity Gases

By RICHARD W. MOONEY
W. CALVIN GUNGLE

THE DECLINE of lumen output during normal burning of fluorescent lamps has been the subject of considerable investigation. Kenty and Cooper[1] studied the effects of gaseous impurities by leaking them into operating fluorescent lamps and noting the effects on voltage, appearance and light output. Of the gases studied, oxygen was most readily cleaned up, whereas hydrogen was the least readily removed. Although considerable information was obtained from this type of accelerated test, it was not extended to include the effects of these gases on actual lamp depreciation during life. Froelich[2] and Lowry et al[3] found that some of the decline in lumen output during burning was due to condensed or adsorbed mercury or mercury compounds on the phosphor surfaces. Froelich maintained that the decrease in lamp efficiency was not due to a change in the phosphor itself whereas Meister and Nagy[4] claimed that the loss in light output was largely the result of photolysis of the fluorescent particles caused by wavelengths below 2000 Å.

Lowry and co-workers[5,6] developed an equation (hereafter designated as the Butler-Lowry equation) with which it is possible to mathematically express the decay of lumen efficiency with burning time. This equation assumes that the decay in efficiency is made up of three separate components as follows: (1) A rapid decay which reaches completion in about 200 hours, due possibly to a gas phase reaction; (2) A slow, "solid phase" reaction, which reaches completion in about 2000 hours; (3) A third very slow decay which is nearly linear for at least 4000 hours. This equation has the form:

$$L_o - L_T = A(1-e^{-aT}) + B(1-e^{-bT}) + C(1-e^{-cT})$$

where L_o = initial efficiency

L_T = efficiency after T hours of operation

T = time in hundreds of hours

a, b and c are constants which depend upon the power/eq. in. of the lamps and, A, B and C are constants for a given lamp or group of lamps but represent variables which determine the difference between good and poor maintenance.

This equation has been used to analyze lumen maintenance curves with considerable success[5-7] and gave impetus to the present investigation of the effects of impurity gases on fluorescent lamp maintenance. It is a commonly accepted fact in the lighting field that impurities in the fill gas are generally to be avoided but quantitative measurements of the effects of these gaseous impurities had not been made. Furthermore, if the Butler-Lowry equation and its assumptions have real meaning then the effects of impurities in the fill gas should be demonstrable in the A term of that equation. This paper presents experimental evidence on the effects of impurity gases on fluorescent lamp starting characteristics, maintenance and discoloration; and interprets these measurements in terms of the chemical constitution of the impurities.

Experimental Procedure

Lamp processing was carried out under as nearly identical conditions as possible except of course for the gas filling step. Sylvania's 3500° white phosphor (acid washed calcium halophosphate) was selected as the phosphor in view of the common use of halophosphate type phosphors in present day fluorescent lamps. Twenty-watt bulbs coated with this phosphor were baked and processed under production conditions except that exhaust tubes were put on both ends of the bulb. A soft-glass stopcock was sealed onto one of the exhaust tubes and a male interchangeable 10/30 ground glass joint was sealed onto the other side of the stopcock.

The processing of the lamp consisted of the usual evacuation, bakeout, activation of the coils, dispensing of mercury and light up. After each step the lamp was flushed with argon and pumped down to about 2×10^{-2} mm Hg. The oven used for baking the lamp was designed so that the stopcock and ground glass joint were below the oven and therefore remained essentially at room temperature. After the final pump down, the lamp was

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filled with argon to about 8 mm pressure and the end opposite the stopcock was tipped off. During this entire procedure, the stopcock remained closed.

The lamp was then transferred to a vacuum system capable of achieving pressures of 1×10^{-5} mm Hg. The lamp was attached to this system through the ground glass joint and after evacuation to a pressure of less than one micron, the stopcock was opened and the lamp was evacuated to a pressure of between 1×10^{-4} and 1×10^{-5} mm Hg. It was then filled with the desired gas mixture to a pressure of 3.0 mm Hg as measured by a calibrated duBrovin gauge. Spectroscopically pure argon was used as the fill gas for the control lamps. Oxygen, nitrogen, carbon dioxide, sulfur dioxide, hydrogen, methane and ethylene were obtained from tanks and subjected to the usual gas purification techniques on admission to the vacuum system. Water vapor which had been vacuum distilled to remove absorbed gases, was obtained from a reservoir in the vacuum system. Each of these so-called impurity gases was quantitatively mixed with spectroscopically pure argon by a system of calibrated gas burettes, a constant volume monometer and a calibrated duBrovin gauge. The details of this procedure are not given here since they consist of conventional gas handling techniques. After the fill gas admission the exhaust tube was sealed off and normal lamp processing procedure was followed.

After processing of the lamps was completed they were left undisturbed for about six hours. Each lamp was then started using a pre-heat type circuit having a manual starting switch. A large variability was noticed in the starting voltage and in the "snaking" of the positive column. Therefore, a means of evaluating starting and "snaking" as a function of the impurity gas was set up. The criteria established for this evaluation are given in Table I. For evaluating lamp starting, the open circuit voltage was set at 110 volts and three separate tries were made to start the lamp using the manual preheat switch. If the lamp did not start, the voltage was increased to the next higher value as given in Table I until the lamp lighted. The amount of "snaking" of the positive column was determined visually.

TABLE I — Factors of Demerit for Starting of 20T12 Lamps.

Starting Voltage	Demerits	Snaking	Demerits
110	0	None	0
125	1	Some	1
150	2	Average	2
175	3	Severe	3
200	4		
225	5		
235	6		
235+ spark coil	7		

TABLE II — Starting Factor of Demerit.

Gaseous Impurity	Factor of Demerit	Number of Lamps Tested
0.98% O_2	1.6	5
0.09% O_2	1.8	6
0.11% H_2O	3.1	7
Control	3.2	17
0.93% SO_2	3.3	6
0.10% N_2	4.1	7
0.97% N_2	4.5	6
0.09% SO_2	6.2	5
0.97% H_2O	6.3	4
0.12% CO_2	6.5	4
0.11% CH_4	7.3	6
0.11% H_2	7.8	7
0.11% C_2H_4	8.0	6
0.95% CO_2	8.2	5
0.74% C_2H_4	9.5	6
0.72% H_2	9.8	5
0.72% CH_4	10	8

The assignment of demerits was cumulative. Thus the minimum number of demerits a lamp could have is 0, the maximum number is 10. A lamp receiving no demerits would start at 110 volts and have no snaking. A lamp receiving 10 demerits would require the maximum circuit voltage in conjunction with a spark coil for starting and, in addition, the swirling of the positive column would be severe.

The completed lamps were subjected to the normal photometry procedure checking electrical parameters, lumen output and discoloration. Readings were made at 0, 100, 200, 300, 500, 750, 1000, 1500 and 2000 hours.

Initial Starting Characteristics

The initial starting factors of demerit of the various lamp types are given in Table II. The gases are grouped in an arbitrary manner (average difference between groups equal to 1.4) in the order of increasing starting factor of demerit. Due to the small samples, these data must be interpreted with caution. However, it is interesting to note that oxygen has a lower factor of demerit than the control. The hydrogen containing gases generally have the higher values. Except for those lamps containing water vapor, all the hydrogen containing gases fall in the last two groups. In speaking of these gases, it is worth mentioning that some 1.0 per cent CH_4 lamps were made and lighted. However, immediately after lighting, the arc voltage started climbing until the arc was extinguished. Several attempts were made to restart the lamps, but they continued to exhibit this behavior. Due to this phenomenon, the higher per cent additions were lowered to about 0.75 per cent for those lamps containing hydrogen, methane, or ethylene.

Maintenance

While the electrical parameters of the various gas groups show little variation from one to an-

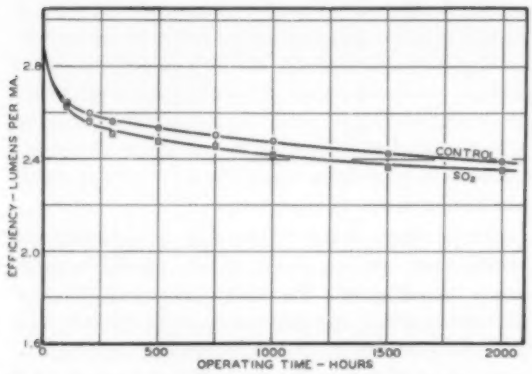

Figure 1. The effect of 0.1-1.0 per cent sulphur dioxide in fill gas on the efficiency of 20-watt lamps as a function of operating time.

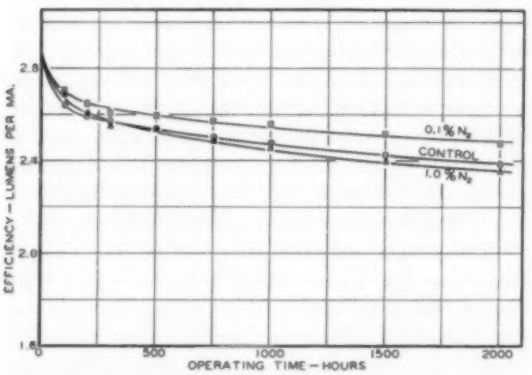

Figure 2. The effect of 0.1 and 1.0 per cent nitrogen in fill gas operating on the efficiency of 20-watt lamps as a function of operating time.

other, the maintenance data vary widely. Units of lumens per milliampere of current rather than the more usual lumens per watt are used since the data expressed in this manner exhibit a smaller degree of scattering. The curves shown in Figs. 1-5 were obtained by analyzing the experimental results by means of the Butler-Lowry equation using a "least squares" method. This method operates by minimizing the sum of the squares of the residuals, or deviations of the computed values of $(L_o - L_T)$ from the observed values of $(L_o - L_T)$. It has the advantage that it gives a unique set of values to the A, B and C parameters — values which do not depend upon the judgment of the investigator in fitting the data to a curve. However, since the data are only carried to 2000 hours of burning and since the experimental sample is small (5 to 7 lamps in most cases) the B and C constants determined by this method are not reliable. The same is not true of the A constant since the effect of this constant is practically completed after only 200 hours of burning.

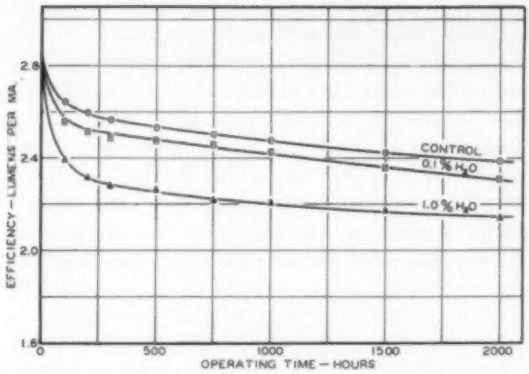

Figure 3. The effect of 0.1 and 1.0 per cent water vapor in fill gas on the efficiency of 20-watt lamps as a function of operating time.

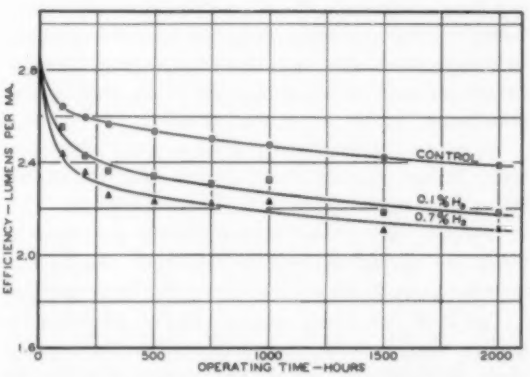

Figure 4. The effect of 0.1 and 0.7 per cent hydrogen in fill gas on the efficiency of 20-watt lamps as a function of operating time.

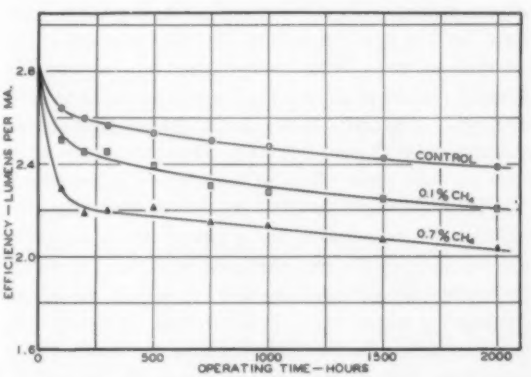

Figure 5. The effect of 0.1 and 0.7 per cent methane in fill gas on the efficiency of 20-watt lamps as a function of operating time.

The method by which the exponents in the Butler-Lowry equation were chosen should be explained. Originally the exponents used by Lowry[7] were $a = 4.0$, $b = 0.2$ and $c = 0.02$. The control

data were analyzed according to these exponents and the "least squares" curve calculated. There was appreciable deviation in the region between 100 to 300 hours of burning which indicated that the a exponent was too large. Accordingly an a value of 2.0 was tried and found to give a theoretical "least squares" curve which was extremely close to the experimental points (rms deviation of 0.0035 lumens per milliampere). All subsequent calculations were made using these values of the exponential constants, i.e.,

$$a = 2.0$$
$$b = 0.2$$
$$c = 0.02$$

The calculated values of A, B and C obtained from the least squares method, together with the accepted values of a, b and c when inserted in the Butler-Lowry equation, give the theoretical drop in maintenance for each time T. A smooth curve drawn through these points gives the most probable curve for the experimental data.

In general, a control was always made whenever other lamps were being processed and, therefore, there were appreciably more control results (17) to average than there were impurity gas results. Thus the variations seen in the other results are smoothed out in the control due to the large sample.

The impurity gases: oxygen, carbon dioxide and sulfur dioxide will be considered together since their behavior in lamps was approximately the same. For oxygen and sulfur dioxide, the difference in results between the low and the high concentrations of each gas was within the experimental errors inherent in the method and, therefore, the data for the two concentrations were averaged and plotted as one. With carbon dioxide, the experimental results indicated that lamps containing 0.95 per cent CO_2 have better maintenance than those containing 0.12 per cent CO_2. However, since both sets of data were close to the control curve, they too were averaged to give one set of experimental points. Of these gases, the greatest deviation from the control results was obtained with SO_2. In Fig. 1 lamps containing SO_2 are compared to lamps containing argon only. It is obvious that even this gas has little effect on maintenance. It is apparent, therefore, that oxygen or gaseous oxide impurities are not responsible for large drops in lumen output.

The maintenance of lamps containing N_2 as the impurity gas as compared to the control are shown in Fig. 2. In general, the results are comparable to Mager's,[8] *i.e.*, small (0.10 per cent) concentrations of N_2 improve the lumen maintenance. With larger concentrations (0.97 per cent) this effect is not as apparent with the halophosphate type phosphor. Thus the "least squares" curve for those lamps containing 0.10 per cent N_2 is appreciably above the control curve whereas the curve for those lamps containing 0.97 per cent N_2 practically coincides with the control. The effects on other phosphors can be more pronounced and the limits can be somewhat different.[8]

The presence of water vapor as an impurity gas in the lamp seriously affects the lumen maintenance (see Fig. 3). This is the first gas thus far considered which has this effect. Both the 0.11 and the 0.97 per cent H_2O lamps have poorer maintenance than the control. The effect increases with increasing concentration of water vapor.

As noted earlier, it was not possible to start lamps containing 1.0 per cent methane; and therefore the maximum concentration of hydrogen or hydrocarbon was limited to 0.75 per cent. Fig. 4 presents data on lamps containing 0.11 and 0.72 per cent hydrogen. As with water vapor the initial drop in lumen maintenance is considerably greater than for the control with the higher concentrations giving the greatest drop. The data for hydrogen containing lamps show considerable fluctuations.

The methane results shown in Fig. 5 are again like those for water vapor and hydrogen. The results for lamps with ethylene as the impurity gas are quite similar except that for some unknown reason the maintenance of the lamps containing 0.11 per cent C_2H_4 was abnormally good. However, since those lamps with 0.75 per cent C_2H_4 had very poor maintenance, the results obtained with the lower concentration of C_2H_4 seem questionable.

Table III gives the A constants determined by the "least squares" method described above. Qualitatively the magnitude of the A term is related to the 0-100 hour drop in maintenance observable in Figs. 1 to 5.

TABLE III — Values of the A Term in the Butler-Lowry Equation for Various Impurity Gases.

Gas	Per Cent	A Term*
Nitrogen	0.10	0.14
Ethylene	0.11	0.17
Nitrogen	0.97	0.18
Carbon Dioxide	0.12/0.95	0.18
Argon	—	0.20
Oxygen	0.09/0.98	0.24
Sulfur Dioxide	0.09/0.93	0.27
Water Vapor	0.11	0.30
Methane	0.11	0.33
Hydrogen	0.11	0.34
Hydrogen	0.72	0.45
Water Vapor	0.97	0.50
Ethylene	0.74	0.63
Methane	0.72	0.65
Methane	0.98	0.74

*Because of the use of lumen per milliampere, these values are numerically low. A value of 0.50 in the present data is approximately equal to 7.0 when lumens per watt is the unit.

Discoloration

Factors of demerit for discoloration of the lamps were calculated for each impurity gas. After approximately 200 hours life the gas phase reaction of a lamp is approximately 98 per cent complete, and at this time, there are four gases whose factors of demerit are less than the factor for the control and continue as such through 1500 hours. These are nitrogen, oxygen, water and sulfur dioxide. After 2000 hours of operation, all the gas-addition lamps have factors which are higher than the control, and those lamps which contain carbon dioxide, hydrogen or a hydrocarbon addition have the highest factors of demerit.

Discussion

The data represented in Figs. 1 to 5 and summarized in Table III indicate that water vapor, hydrogen, methane and ethylene give the most serious degradation in lumen output. Small concentrations of nitrogen seem to be advantageous whereas oxygen, carbon dioxide and sulfur dioxide have little, if any, effect. Thus the gases may be divided into three main groups according to their effect on lumen maintenance: (1) nitrogen, (2) oxygen and gaseous oxides and (3) hydrogen, water vapor and hydrocarbons.

Those gases which have the greatest effect have one thing in common, namely, hydrogen atoms in the molecular structure. It is obvious from Figs. 3 to 5 that increasing amounts of these gases in the lamp magnify the effects, but it is also apparent that the deleterious effect of these gases is not directly proportional to their molecular concentrations. For example, Table III shows that 0.72 per cent CH_4 or 0.74 per cent C_2H_4 have larger A terms (0.65 and 0.63 respectively) than does 0.72 per cent H_2 or even 0.97 per cent H_2O (0.45 and 0.50 respectively). However, a linear relationship does exist between the "hydrogen atom" concentration and the effects of these gases as evidenced by the 100 hour lumen per milliampere readings, or the A values. This straight line relationship is shown in Figs. 6 and 7 respectively. In Figs. 6 and 7 the highest hydrogen concentration corresponds to the one lamp containing 0.98 per cent CH_4 which remained lighted after starting. Although it is somewhat dangerous to draw conclusions from a single lamp, it is interesting that the data for this lamp fall in line with the other results.

There seems to be considerable evidence to support the hypothesis that these hydrogen containing gases are broken down in the arc discharge. For example, Mitchell and Zemansky[9] give detailed accounts of many of these reactions. Furthermore, there are many references in the literature to support this assumption. For example, the thermal decomposition of methane, as proposed by Kassel,[10] goes through a four-step process to form acetylene which then dissociates into carbon and hydrogen, *i.e.*:

$$CH_4 \longrightarrow CH_2 + H_2$$
$$CH_2 + CH_4 \longrightarrow C_2H_6$$
$$C_2H_6 \longrightarrow C_2H_4 + H_2$$
$$C_2H_4 \longrightarrow C_2H_2 + H_2$$
$$C_2H_2 \longrightarrow 2C + H_2$$

This process takes place at temperatures as low as 700C and possibly lower. Such temperatures or energies are found in a mercury discharge. Therefore, we may assume that water vapor, methane and ethylene dissociate in the presence of a mercury discharge yielding hydrogen gas, and since there are several ways in which hydrogen gas may dissociate in the presence of excited and metastable Hg[11] the end product of all these gaseous impurities is atomic hydrogen.

On the assumption that all of the hydrogen in the molecule is changed to "active hydrogen atoms"

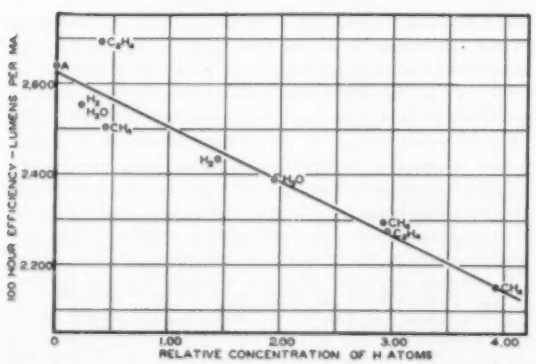

Figure 6. The effect of H atom concentration on 100-hour efficiency values.

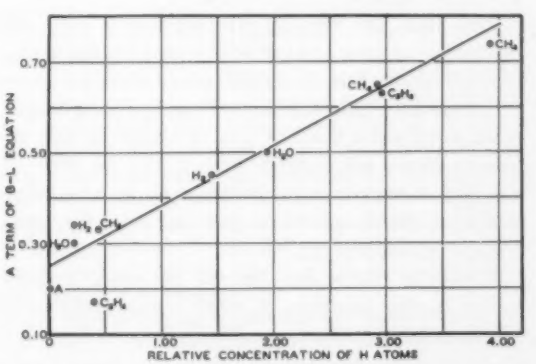

Figure 7. The effect of H atom concentration on the A term of the Butler-Lowry maintenance equation.

the linear relationship between the initial drop in lumen output and the hydrogen atom concentration is explainable. For instance, active hydrogen might be reacting with the phosphor surface to form OH bonds which would absorb a portion of the u.v. generated in the plasma. The electronic charge balance might also be affected by the reaction of atomic hydrogen with the phosphor resulting in a change of valence state of the activator atom(s).

The practical implication of these results is that extreme care should be taken to avoid the possibility of phosphor contamination by water vapor or hydrocarbons. Contamination by water vapor will undoubtedly take place on long holdover before baking, especially with those phosphors which have a large surface area. Contamination by hydrocarbons and/or water vapor may take place either during bakeout or later in final processing in the form of tiny droplets carried into the lamp by an air stream or by absorption of vapor from the ambient atmosphere. Either of these will eventually result in the presence of hydrogen in the lamp with its resultant effect on maintenance. Incomplete breakdown of the binder during baking may also leave a carbonaceous residue containing an appreciable amount of hydrogen. It should be noted further than 1 per cent water vapor in the fill gas represents only 0.02 milligrams of water. Similarly those gases which do not contain hydrogen, such as oxygen, nitrogen, carbon dioxide, sulfur dioxide, etc., do not result in poor maintenance although they may give difficulty in starting.

From Table III giving the values of the *A* term in the Butler-Lowry equation for various gases and from Fig. 7 it may be seen that the magnitude of the *A* term is determined by the impurity gas as was originally hypothesized in the development of the Butler-Lowry equation.[5] Furthermore, the similarity in the type of curves shown in Figs. 6 and 7 also support this conclusion.

The data on starting characteristics and discoloration are not as easy to interpret as the maintenance data, but it would seem that the same processes are occurring here. That is, the hydrogen containing gases seem to give the most trouble although there are notable exceptions. In view of the lack of corroborative evidence no definite interpretation can be placed on these results, other than the one already given.

Similarly the reason for the improved maintenance in the presence of small concentrations of nitrogen is at present unexplainable.

Conclusions

Fluorescent lamp maintenance is relatively unaffected by oxygen or gaseous oxides. Water vapor, hydrogen or hydrocarbons are detrimental to maintenance, the extent being directly proportional to the concentration of "active hydrogen" available after complete breakdown of the impurity gas. These same gases also give hard starting lamps and often show considerable discoloration. Nitrogen in small concentrations improves the maintenance.

The basic assumption of the Butler-Lowry equation regarding the effect of gaseous impurities has been found to hold true.

Acknowledgments

The authors are indebted to Dr. E. F. Lowry and Dr. K. H. Butler for their interest in and discussions of this work. In addition, the assistance of Messrs. F. P. Mackey and G. R. Spears of the Product Engineering Department, Danvers, Mass. is gratefully acknowledged.

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DISCUSSION

D. D .HINMAN:* One way or another, we are all interested in the lumen decline during life of fluorescent lamps. Although a great deal of data has been accumulated on the effect of gaseous contaminants, this paper is the most complete report on this subject that has been presented. The authors' demonstration of the unique role played by hydrogen is a new and valuable contribution. Much of the data on the effect of contaminants with which we are familiar has not been published for the one reason that repeat tests at various times have given inconsistent results. This variability indicates that the mechanism by which some gases affect lumen depreciation is not a simple one, but involves several variables in lamp processing.

The data in Table II on lamp starting would be more useful if the starting voltage and degree of snaking had

*General Electric Co., Cleveland, Ohio.

been reported separately. I would like to ask the authors whether the starting demerits were made on the first start, or whether the lamps had been operated for a short period beforehand. Some of the starting voltages are lower and some are higher than I would expect. For example, the control lamps filled with pure argon were either hard starting or showed severe snaking. Does not this indicate that these lamps contained some gaseous contaminant also?

The Butler-Lowry equation is useful and convenient to express lumen depreciation throughout lamp life. A very close approximation to the actual data can be obtained by proper selection of the six arbitrary constants. Yet, we believe there is little evidence to justify the contention of the present authors and others that the three terms of the equation have separate physical significance. It is true that gaseous contaminants have a marked effect early in lamp life and this causes a large change in the A term. However, if the A term is exclusively that of a gas reaction and the B and C terms represent other processes, one would expect the B and C coefficients to remain unchanged by the addition of a gas to the lamps. It is easily shown from the authors' data that this is not true. For example, using the data presented in Fig. 5 of their paper, comparing 0.7 per cent methane with pure argon, one can calculate that the sum of the B and C terms is 30 to 40 per cent lower with methane than with argon. We have found that contaminants which cause rapid depreciation early in lamp life frequently cause better maintenance later in life.

Studies of the effects of solid contaminants in phosphor have often yielded results difficult to explain chemically. It could well be that water held by some of these is the real offender instead of the primary material being tested.

GEORGE MEISTER:* This paper is very interesting and should be valuable to the lamp industry. It indicates the necessity of "good housekeeping" in lamp manufacturing when such harmful impurities, as listed in the paper, may unintentionally be introduced.

The authors' arrangement of adding gas to the lamp through stopcocks and ground-glass joints may introduce some impurities. They mention the purification of gases but do not give an analysis of the ultimate gas used. This may be insignificant but might be interesting information.

It would also be desirable to know how long the impurity gases remain in the discharge and affect the operating voltage of the lamps. Specifically, what was the change in operating volts in the lamp for the various impurities during the first 200 hours. Measurements made in our laboratories indicate that the O_2 containing gases, N_2, and small quantities of H_2 clean up in a few minutes of operation. Lowry has stated that the ultraviolet output of the discharge is constant throughout the life of the lamp. Is not the ultraviolet output affected by these impurities in the gas if they remain in the gas phase?

Since the control shows a lumen drop in the first 100 hours, can it be concluded that this decrease is caused by residual gas in the phosphor or is it due to a photochemical effect of the short ultraviolet on the phosphor? If the latter, might the photochemical effect change with gas purity?

A breakdown of the total demerits to indicate the effects of the individual impurities on starting and snaking would be interesting. In addition, how long does the snaking last?

*Research Department, Westinghouse Lamp Division, Bloomfield, N. J.

R. W. MOONEY and W. C. GUNGLE:* We certainly agree with Mr. Hinman that the mechanism by which gases affect lumen depreciation is not a simple one and we believe that our data have demonstrated this point, at least to a limited degree. We, too, had difficulty reproducing results when the phosphor concerned was one of the tungstates. However, with the halophosphate system, we were able to check our results on separate runs over a period of several months.

With regard to lamp starting, the starting demerits shown in Table II were determined on the first start of the lamps. The fact that the control lamps containing pure argon started with somewhat greater difficulty than lamps containing oxygen, may be explained as follows. All of the lamps reported on in this paper were more thoroughly evacuated than is normal in production procedures and, therefore, it is possible that some necessary constituent for starting is being removed. Since oxygen was also effective in producing improved starting in lamps containing magnesium tungstate phosphor, it may be that trace quantities of oxygen are necessary to produce good starting characteristics. In answer to Mr. Meister, the duration of snaking in starting depends upon the particular impurity gas and, therefore, upon the severity of the snaking. In some cases, the snaking lasts only a few seconds; in other cases, it lasts for several minutes.

In answer to Mr. Hinman's question regarding the use of the Butler-Lowry equation, we should like to point out that although the equation does contain six constants, three of these are fixed for a given voltage loading as in this study and, therefore, only three of the constants may be arbitrarily varied to account for differences in lumen depreciation. We agree that there is undoubtedly some interaction between the A, B, and C coefficients and that therefore the A term is probably not exclusively related to a gas phase reaction. However, the present data support the contention that the A term is largely dependent upon the impurity gases present in the lamp. Perhaps when a phosphor is severely affected by a gas phase reaction in the early stages of burning, the effects of the B and C terms are not so prominently seen due to the inability of the phosphor to depreciate further.

In answer to Mr. Meister's comments regarding the introduction of impurities to the lamps via the stopcock grease in the system, it would seem that although this is a possibility, the amount of impurities that would be added would be minute since high vacuum stopcock grease was used and we were very careful not to blow any of this grease into the system. However, assuming that some impurities were unintentionally introduced in this manner, they would probably be added in relatively constant amounts to each lamp due to the similarity of treatment, and therefore, their effect should be cancelled out. The gases used had a purity of 99 per cent or greater to start with and, as mentioned in the paper, were purified by conventional high vacuum techniques. No analysis was made, but it is believed the final gases were in the neighborhood of 99.99 per cent pure. It is our opinion that the impurity gases do not remain in the discharge more than a few seconds, or at most a few minutes. Unfortunately, we do not have a record of the change in operating voltage of the lamps over the first few hundred hours, except at the times indicated in our paper. At these times, there was essentially no change.

Mr. Meister has asked whether the ultraviolet output should not be affected by the impurity gases remaining in the gas phase. One of the main points of the paper is that

*Authors.

impurity gases do not remain in the gas phase, but rather are dissociated to their atomic constituents and react with the phosphor or metal surfaces in the lamps. The authors do not have any explanation for the lumen drop in the controls over the first few hundred hours. As mentioned by Mr. Meister, it could be due to residual gases in the phosphor or perhaps to some effect as yet unknown. The reason for this drop could be the subject of a further study.

Some Factors That Influence the Design of Exposed Lamp Signs for Daytime Effectiveness

(Discussion of paper by A. L. Hart, published in the October issue of ILLUMINATING ENGINEERING)

WILLARD C. BROWN:* It gives me great pleasure to see that the time has come when signs bright enough to really attract attention in the daytime are becoming practicable and within the limits of what people will spend for such kind of compelling advertising. It is a good illustration of a point I sometimes make with our younger lighting engineers . . . that there are quite a number of lighting developments brought out on various occasions, which are really too far ahead of their time. At the time they come out, the lack of some material or method makes them impracticable. Then, sometimes years later, new materials or methods make the idea entirely practicable and useful.

So with the "daylight" sign. Some thirty years ago, some of us got the idea that it would be a fine thing to have signs with letters bright enough to attract attention in the daytime. We actually made such a sign. But its complications and high cost made it impracticable. Now, so many years later, with new lighting tools with which to work, such as the PAR lamps, it seems to be becoming quite practicable and economical to have such signs.

This first daylight sign was installed way back in 1926 . . . which was before Light's Golden Jubilee. It was on the side of the General Electric exhibit on the Central Pier at Atlantic City. The letters were actually bright enough to compete effectively with the well-known Atlantic City sunshine.

But what a complicated affair it was! We made up a number of parabolic reflectors, 18 inches in diameter, of polished copper, and had them chromium-plated. (This was before the days of polished Alzak.) Then we cut them in square shape, and fitted them together in a long row. A clear 200-watt filament lamp was used in each, with a micrometer adjustment so that the filament could be placed at the focal point of the reflector. Then over the row of reflectors was placed a rippled glass to smooth out streaks and striations, and over that a metal stencil with the words "General Electric." We aimed it directly down the boardwalk. As you approached, even on the brightest day, with the sun shining right on the sign, the letters really commanded attention.

At night the letters were, of course, too bright. We took care of that by operating each pair of lamps in series during the night hours. Later, we put it on a dim-flasher which alternately and smoothly dimmed and brightened the lamps over a cycle of several seconds. This was very effective in the daytime too.

Well, we thought this quite an idea at the time, but the cost and complications of getting it just right evidently prevented any one else from adopting it. Now, so many years later, here we have a number of large signs with letters bright enough to command attention in bright sunlight — thanks to new sources and materials. And Mr. Hart comes out with this excellent paper on how to design such signs — carrying further the fine sign design work of Carl Atherton and Wentworth Potter so many years ago. It is a real delight to see this progress.

*General Electric Co., Nela Park, Cleveland, Ohio.

Lighting for Audio-Visual Teaching

(Discussion of paper by Carl J. Allen, published October 1956 ILLUMINATING ENGINEERING)

WILLARD ALLPHIN:* This excellent paper is so complete that very little can be said by way of comment. However, I should like to further point up the fact that audio-visual teaching is done more and more in the classroom rather than in special rooms. It seems to me that architects and school building committees fail to realize this and provide room after room with no convenient means of partially darkening the interior.

*Sylvania Electric Products Inc., Salem, Mass.

INSTALLATION AT BILTMORE HOTEL GALERIA ROOM, 515 SOUTH OLIVE ST.
LOS ANGELES, CALIF.

Lighting a Hotel Dining Room

LIGHTING OBJECTIVE: To provide a comfortable atmosphere with variable levels of illumination for both banquet and relaxation type dining.

GENERAL INFORMATION: This newly decorated room measures 55 feet by 88 feet with ceiling heights of 10 feet 9 inches in the luminous ceiling area, 9 feet 9 inches in the side areas and 8 feet 9 inches in the back area. Colors and reflectances in this room are as follows:

	Color	Reflectance
Ceiling		
Plenum above plastic	White	75%
Acoustical tile	White	75%
Walls	Mustard Yellow	45%
Pillars	Chinese Red	23%
Carpet	Mustard Yellow	41%
Tablecloths	White	86%
Chair seats	Burgundy	25%

(over)

A.I.A. File No. 31

INSTALLATION: Single lamp Light Control units equipped with 40-watt T-12 standard warm white fluorescent lamps are mounted on 24-inch centers 15 inches above the 34-foot x 58-foot plastic luminous ceiling manufactured by the Shugart Company. The ceiling consists of 2-foot x 2-foot plastic sections.

There are seventeen 4-foot square surface-mounted drop plastic luminaires arranged around the periphery of the room. Eight of these, Light Control catalog No. LC-6307 RS equipped with seven 40-watt T-12 standard warm white fluorescent lamps, are located in the side areas. The nine remaining, Light Control catalog No. LC-6308 RS equipped with eight 40-watt T-12 standard warm white fluorescent lamps, are located in the front and back areas.

Around the edges of the luminous ceiling area, on 6-foot centers, there are thirty-three adjustable eyeball units with concentric louvers, Light Control catalog No. LCFR-40, each equipped with one 150-watt R-40 flood lamp.

All of this lighting is controlled by Ward Leonard 24-volt remote control dimmers. The maximum general level of illumination is 95 footcandles in the luminous ceiling area and 152 footcandles in the side and back areas. Brightness values with maximum illumination are as follows:

Luminaires	
4′ x 4′ luminaire	1400 ft-L
luminous ceiling	150 ft-L
Acoustical tile ceiling	12 ft-L
Walls	12 ft-L
Pillars	6 ft-L
Carpet	28 ft-L
Tablecloths	81 ft-L
Chair seats	23 ft-L

Lighting designed by Chauncy E. Mauk, 124 West 4th St., Los Angeles, Calif.; Luminous ceiling designed by Sylvester Huges, 13049 Chase St., Pacoima, Calif.; Electrical Contractor, California Electrical Construction, 2003 South Olive St., Los Angeles, Calif.

Lighting data submitted by Don Romanoff, Ruby Lighting Corp., 1212 South Olive St., Los Angeles, Calif., as an illustration of good lighting practice and to aid in the design of similar installations.

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Interior Lighting With High Output Fluorescent Lamps

By W. H. JOHNSON

PUBLICIZING and availability of high output rapid start fluorescent lamps is placing the lighting design, application, and sales engineers on the receiving end of the "What? Where? How Much?" triumvirate of questions. What fixture can I use it in? Where do I locate them? How much will it cost? These questions require considerable time in order to test and evaluate all possibilities. The purpose of this paper is to investigate the performance and economic suitability of adapting current luminaire designs for use with this new rapid start lamp.

The high output rapid start lamp is available in lengths of 2 feet, 4 feet, 6 feet and 8 feet. Due to time and space limitations this analysis is confined to the 8-foot lamp, which, it is believed, will be the most active lamp for interior lighting. The physical characteristics of this lamp closely follow those of the 8-ft slimline lamp and suggest the substitution of the new 8-ft rapid start lamp in luminaires presently designed for the 8-ft slimline lamp. The only changes required to make the unit operative are new lamp holders and ballast. Table I lists the physical, electrical, and photometric characteristics of the 8-foot rapid start lamp, 8-foot slimline lamp, and for later analogies, the 90-watt preheat lamp.

Since the substitution of suitable lamp holders and ballast in a commercially available luminaire is relatively simple, compared to designing a unit from the ground up, the immediate use of the new rapid start lamp seemed obvious. There are, however, pertinent questions of design and performance that must be answered to the satisfaction of the lighting engineer. Basically what must be determined is first, will this coallesced unit conform to Underwriters' Laboratory Standards, and secondly, do performance and economic studies indicate savings over presently available lamp and luminaire combinations? Interior lighting luminaires can be divided simply into Industrial and Commercial types. Although materials and construction techniques vary greatly between manufacturers, general classification by photometric distribution is possible.

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 17-21, 1956, Boston, Mass. AUTHOR: Westinghouse Electric Corp., Lighting Division, Cleveland, Ohio.

Industrial Lighting

The most logical place to use this new high output source is in industrial application where relatively high mounting heights are available and where high output light sources are in common usage today.

Performance Data

Three common types of 8-ft slimline industrial fixtures were modified to handle the 8-ft rapid start lamp. They are the totally direct luminaire, ventilated reflector type luminaire having an approximate 10 per cent upward component, and the slotted reflector type luminaire having an approximate 20 per cent upward component. The latter two units conform with the standards of the RLM Standards Institute. All three modified luminaires conform to Underwriters' Standards when suspen-

TABLE I — Dimensional, Electrical and Photometric Characteristics.

	LAMP TYPE		
	Rapid Start F96T12/ RS/CW	Slimline F96T12/ CW	Pre-heat F90T12/ CW
Physical Characteristics			
1. Length — nominal	96″	96″	60″
2. Length — luminous	93″	92½″	57″
3. Diameter	1½″	1½″	2⅛″
4. Base Design	Recessed pin	Single Pin	Mog. pin
Electrical Characteristics			
1. Watts	100	74	90
2. Open circuit volts	465	650	150
3. Operating volts	135	195	65
4. Operating amps	0.850	0.425	1.55
5. Two-lamp ballast loss	45	35	30
Photometric Characteristics (cool white lamp)			
1. Initial lumens	7250	5050	5100
2. Lumens per foot	906	631	1020
3. Brightness (c/sq. in.)	6.1	4.3	4.9
Efficiency			
1. Lamp only — lumens/watt	72.5	68.2	56.7
2. Lamp & ballast — lumens/watt	59.2	55.2	48.5

sion mounted on 18-inch hangers. Photometric distribution curves, for each unit, were next run according to the IES Guide for the Photometric Testing of Fluorescent Luminaires.[1] Coefficients of utilization were then calculated for each luminaire according to the IES currently preferred method.[2]

Table II is a comparison of the efficiency of the different classification luminaires and compares the same type luminaire using either the 8-ft slimline lamp or the 8-ft rapid start lamp. The efficiency comparison between 8-ft slimline and 8-ft rapid start lamps in similar luminaires is exceptionally close and gives no indication of luminaire performance change when switching from the slimline lamp to the rapid start lamp.

The candlepower distribution curve shapes are also essentially the same. Table III is a comparison of various zonal lumen sums, given in per cent bare lamp lumens, for the totally direct luminaire using either slimline or rapid start lamps. Comparisons of the other type luminaires are similar, and as might be expected, calculated coefficients of utilization for either lamp, when used in the same type luminaire, are almost identical.

It would seem from these performance figures that the present luminaire designs are adequate to handle the new lamp. Discretion on the part of the application engineer in using this new tool is, however, warranted. The limitations of a high output source are often recognized but not applied. As shown in Table I, the brightness of this new lamp is considerably higher than the lamp brightness of the commonly used fluorescent lamps. This high brightness should be an immediate red flag cautioning its use at low mounting heights or for low illumination level applications. When used at low mounting heights, additional shielding is required to prevent excessive glare.

Economic Comparison

For economic comparison, the cost analysis shown in Table IV was derived. The 8-ft rapid start lamp in a ventilated luminaire is compared to a similar unit using the 8-ft slimline lamp and a similar distribution type unit using the 90-watt preheat lamp. Included in this analysis, is a ventilated high bay luminaire using the 400-watt color corrected mercury lamp with either a wide or narrow distribution. The cost analysis is based on an industrial area of 20,000 sq ft, having a room index of C, and to be provided with 50 footcandles maintained. In making a cost analysis, it is always necessary to make certain assumptions, the more important of these assumptions being energy rate, burning hours per year, and amortization period for equipment cost. In this analysis the energy rate selected was $0.01 per kilowatt hour; the burning hours per year estimated at 4000 hours, and an amortization period of 10 years assumed for equipment costs.

TABLE II — Efficiency Comparison of Industrial Luminaires Using Slimline or Rapid Start Lamps.

Luminaire Classification	Lamp	Luminaire Efficiency
Totally Direct	Slimline	79.6%
	Rapid-Start	78.7%
Ventilated 10% Upward	Slimline	85.5%
	Rapid-Start	84.8%
Slotted 20% Upward	Slimline	86.7%
	Rapid-Start	87.9%

TABLE III — Comparison of Zonal Lumen Sums for Totally Direct Industrial Luminaire.

Zone	Lumen Sums in % of Bare Lamp Slimline	Rapid-Start
0° - 30°	19.4	19.4
0° - 40°	32.7	32.7
0° - 60°	61.5	61.0
0° - 90°	79.6	78.7

Line 20 of the cost analysis, Total Initial Cost, shows the rapid start unit to be the lowest of the fluorescent systems but higher than either of the mercury systems. Line 34, Total Annual Maintenance Cost, shows the rapid start luminaire least expensive of all the systems. The mercury units suffer here from the high individual cost of replacement lamps. Line 35, Annual Energy Cost, again favors the rapid start system over all others. Line 38, Relative Annual Cost, shows the rapid start lamp to an economic advantage over all systems compared except the narrow distribution mercury high bay, in which case, it is still very comparable.

Since industrial plant energy rates vary considerably, a curve was plotted of Total Annual Cost for each system in Per Cent of Rapid Start Annual Cost vs. Energy Rate in Cents per Kilowatt Hour. Fig. 1 shows the effect of various energy rates on the relative cost of the different systems. The rapid start system maintains its advantage over the other fluorescent systems and the wide distribution mercury system, and at higher energy rates even becomes slightly less expensive than the narrow distribution mercury system.

Not only does the energy rate vary, but number of burning hours per year differs widely in industry. A curve, therefore, was plotted of Total Annual Cost for each system in Per Cent of Rapid Start Cost vs. Burning Hours per Year, and is shown in Fig. 2. In this case the relative annual cost between fluorescent systems followed essen-

TABLE IV — Cost of Lighting Analysis for Typical Industrial Area of 20,000 Square Feet. Room Index of "C." To Provide 50 ft-c Maintained.

	LIGHTING SYSTEM NUMBER	I	II	III	IV	V
DESCRIPTION OF LIGHTING SYSTEMS	1. Type of lamp (fil., merc., preheat fluor., slimline, etc.)	Preheat Fluor.	Slimline	Rapid Start	Fluor. Merc.	Fluor. Merc.
	2. Lamp description	F90T17/CW	F96T12/CW	F96T12/CW/RS	400W J-H1	400W J-H1
	3. Type of luminaire	Ventilated Fluorescent	Ventilated Fluorescent	Ventilated Fluorescent	Ventilated High-Bay Wide Distr.	Vent. High-Bay Narrow Distr.
	4. Number of lamps per luminaire	4	2	2	1	1
BASIC DATA	5. Rated initial lamp lumens per luminaire	20,600	10,100	14,500	20,000	20,000
	6. Lamp life	7,500	7,500	7,500	7,000	7,000
	7. Watts per luminaire (including auxiliary)	438	183	245	445	445
	8. Coefficient of utilization RI = C Refl. 50% 50%	0.66	0.66	0.66	0.66	0.74
	9. Maintenance factor: Good	0.70	0.70	0.70	0.73	0.73
	10. Number of luminaires	105	214	149	104	93
	11. Average footcandles maintained	50	50	50	50	50
	12. Energy rate ($ per kwh)	$ 0.01	0.01	0.01	0.01	0.01
	13. Estimated burning hours per year	4,000	4,000	4,000	4,000	4,000
INITIAL COST	14. Net luminaire cost (each)	$ 67.00	39.00	47.00	17.00	19.50
	15. Net additional accessory cost per luminaire	$ 1.00*	1.00*	1.00*	23.00**	23.00**
	16. Estimated wiring & installation cost per luminaire	$ 50.00	23.00	29.00	50.00	50.00
	17. Net initial lamp cost each (list less 30%)	$ 1.89	2.45	2.70	15.70	15.70
	18. Net initial lamp cost per luminaire (4×17)	$ 7.56	4.90	5.40	15.70	15.70
	19. Total initial cost per luminaire (14+15+16×18)	$125.56	67.90	82.40	105.70	108.20
	20. TOTAL INITIAL COST (10×19)	$13,184	14,531	12,278	10,993	10,063
ANNUAL FIX. CHG.	21. Initial cost per luminaire less lamps (14+15+16)	$118.00	63.00	77.00	90.00	92.50
	22. Total initial cost less lamps (10×21)	$12,390	13,482	11,473	9,360	8,602
	23. ANNUAL FIXED CHARGES (15%† of 22)	$ 1,858	2,022	1,721	1,404	1,290
ANNUAL OPERATING COSTS	24. Annual no. lamp replacements (4×10×13÷6)	224	228	159	59	53
	25. Annual cost of replacement lamps (17×24)	$ 423	559	429	926	832
	26. Annual cost of replacement parts (starters, etc.)	$ 10	——	——	——	——
	27. Total annual maintenance material cost (25+26)	$ 433	559	529	926	832
	28. Estimated labor cost to replace one lamp	$ 0.75	0.75	0.75	0.50	0.50
	29. Total labor cost to replace lamps (24×28)	$168.00	171.00	119.00	30.00	26.50
	30. Estimated cleaning cost per luminaire	$ 2.00	1.50	1.50	1.00	1.00
	31. Number of cleanings per year	one	one	one	one	one
	32. Annual cleaning cost (10×30×31)	$ 210	321	224	104	93
	33. Total annual maintenance labor cost (29+32)	$378.00	492.00	343.00	134.00	119.50
	34. Total Annual Maintenance Cost (27+33)	$ 811	1,051	772	1,060	952
	35. Annual Energy Cost (7×10×12×13÷1000)	$ 1,840	1,566	1,460	1,851	1,655
	36. TOTAL ANNUAL OPERATING COST (34+35)	$ 2,651	2,617	2,232	2,911	2,607
TOTAL AND REL. COSTS	37. TOTAL ANNUAL COST (23+36)	$ 4,509	4,639	3,953	4,315	3,897
	38. Relative Annual Cost	114%	117%	100%	110%	98%
	39. Annual Cost per Footcandle (37÷11)	$ 90.18	92.78	79.06	86.30	77.94
	40. Relative Annual Cost per Footcandle	114%	117%	100%	110%	98%

*End plates and mounting accessories.
**Ballast.
†Usually 15 per cent assuming 10-year amortization with 5 per cent allowance for taxes, insurance and interest.

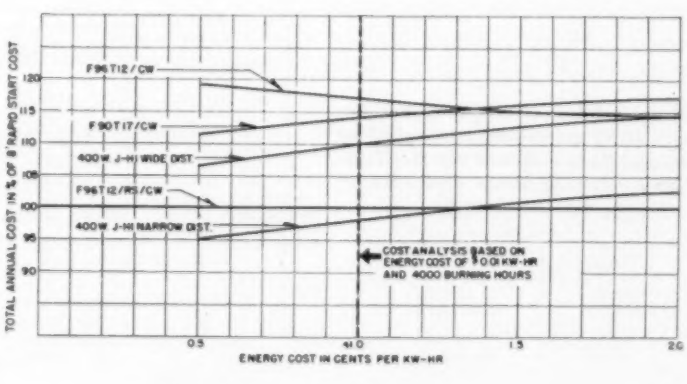

Figure 1. Effect of energy cost on relative annual cost for typical industrial fluorescent and mercury luminaires. Room ratio 3.0. Burning hours per year 4000.

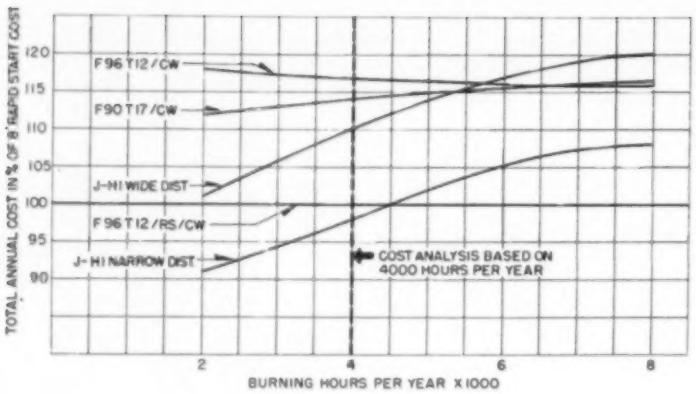

Figure 2. Effect of increased burning hours per year on relative annual cost for typical industrial fluorescent and mercury luminaires. Room ratio 3.0. Energy rate $0.01/kwh.

tially the same curve as when energy rate was varied. The relative cost of the mercury system compared to the rapid start fluorescent, however, shows a much more rapid change. The high individual cost of replacement lamps for mercury systems causes a sharp relative annual cost increase for these systems, as burning hours per year are increased. Conversely, the relative annual cost decreases when burning hours are decreased.

The effect of various room proportions or room ratios was next studied. Fig. 3 is a curve of Total Annual Cost for each system in Per Cent of Rapid Start Cost vs. Room Ratios. The coefficients of utilization for various room ratios for all fluorescent luminaires and for the wide distribution mercury luminaire, are so similar, that for all intents and purposes they are the same. The relative annual cost per luminaire in each system, therefore, remains approximately the same and the constant percentage difference is indicated by the straight lines shown on Fig. 3. The coefficients for the narrow distribution high bay, on the other hand, become proportionately higher, compared to the other luminaires, as the room ratio decreases. This gives the narrow distribution high bay an increasing advantage over the other luminaires at lower room ratios.

Commercial Lighting

The use of high output light sources in the commercial lighting field is stringently limited by quality restrictions, particularly those limiting luminaire brightness. This is especially true in the fields of school and office lighting. In order to meet these restrictions, completely new luminaires may have to be designed; however, modification and performance of existing designs is the immediate problem.

Performance Data

Three commercial luminaires were converted to handle the 8-ft rapid start lamp. They are a 4-lamp direct-indirect type luminaire with 30° x 30° louvered shielding, a 2-lamp semi-indirect type luminaire with a solid, luminous, plastic bottom, and a 2-lamp bare lamp luminaire with direct type

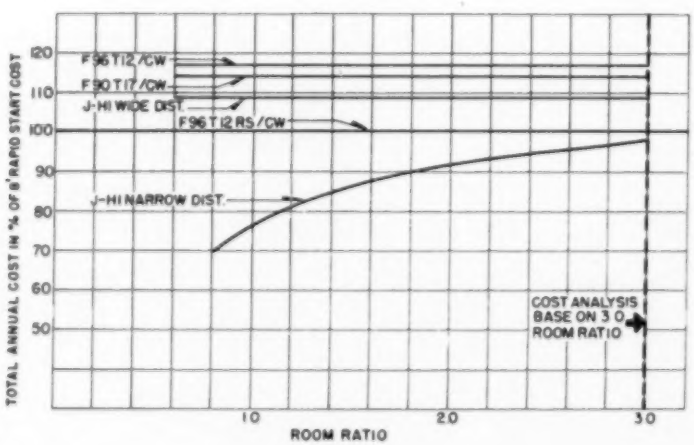

Figure 3. Effect of various room ratios on relative annual cost for typical industrial fluorescent and mercury luminaires. Burning hours 4000. Energy rate $0.01/kwh.

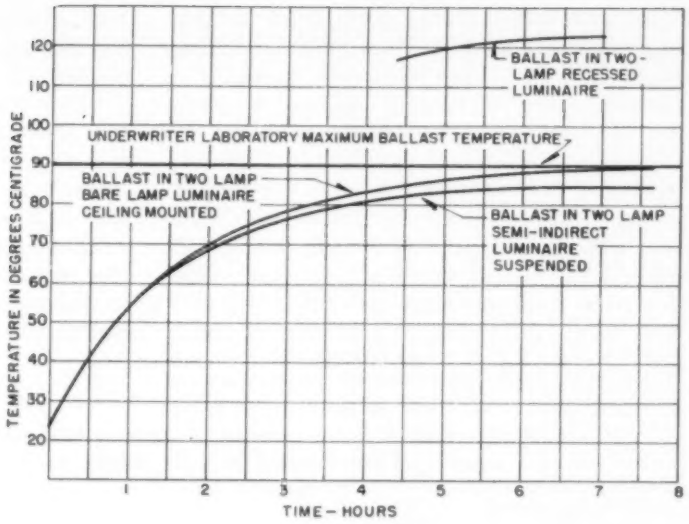

Figure 4. Ballast temperature vs. time for typical commercial luminaire using 8-foot high-output rapid-start lamp.

distribution. When suspension-mounted, the three converted luminaires conform to Underwriters' Standards. Ceiling mounting of the luminaires, however, caused the ballast temperature to become excessive. Fig. 4 shows the ballast temperature curves for several units tested. A standard recessed unit failed to conform to Underwriters' Standards in regard to maximum temperature based on an ambient temperature of 25°C. A ceiling mounted bare lamp unit gave maximum temperatures readings barely allowing it to conform with Underwriters'. Since the temperature measuring devices used are accurate to within plus or minus 4°F, this indicates failure to conform to Underwriters' Standards. The semi-indirect unit, and all other suspended luminaires, safely conform to Underwriters' Standards.

Obviously, air circulation is required over the top of the luminaire channel to dissipate ballast heat. Additional heat tests, as yet incomplete, are being run to determine how far below the ceiling a luminaire must be mounted to insure sufficient heat dissipation. With present luminaire designs, surface mounting of luminaires does not appear practical.

Following the IES Guide for the Photometric Testing of Fluorescent Luminaires,[3] photometric distribution curves for the three different classification luminaires were run. Table V compares the efficiencies of these luminaires using the 8-ft rapid start lamp or the 8-ft slimline lamp. The difference between efficiencies here, compared to those in Table II for industrial luminaires, is considerably greater. Particularly in the case of the semi-indirect luminaire with a solid plastic bottom, the efficiency of the 8-ft rapid start unit is almost seven per cent below that of the same unit with 8-ft slimline lamps. In the case of the direct-indirect unit, the drop in efficiency is almost three per cent and for the direct unit slightly more than three per cent. One explanation for this decrease in efficiency is the effect of bulb wall temperature of the lamp on light output. Maximum light output is obtained from a fluorescent lamp at a bulb wall temperature of approximately 100°F.[4] At normal room temperatures fluorescent lamps will operate around this optimum bulb wall temperature. As bulb wall temperature increases over 100°F, light output drops off. Two of the factors affecting bulb wall temperature are current loading of the lamp and ambient temperature of air surrounding lamps. The more heavily a given lamp is loaded (watts per unit area of bulb wall surface), the higher its bulb wall temperature. Also, raising the ambient temperature in which the lamp is operating, will raise the bulb wall temperature. The 8-ft rapid-start lamp, having the same bulb diameter and being approximately equal in length to the 8-ft slimline but loaded to 850 ma compared to 425 ma, has a

TABLE V — Efficiency Comparison of Commercial Luminaires Using Slimline or Rapid Start Lamps.

Luminaire Classification	Lamp	Luminaire Efficiency
Direct-Indirect	Slimline	86.3%
	Rapid-Start	83.9%
Semi-Indirect	Slimline	74.6%
	Rapid-Start	67.3%
Direct (Bare Lamp)	Slimline	88.5%
	Rapid-Start	85.1%

higher bulb wall temperature than the slimline lamp, when both are operated at the same ambient temperature. Enclosing fluorescent lamps in a luminaire raises the ambient operating temperature compared to a bare lamp in free air, but circulating air currents tend to dissipate this heat by convection, thus limiting rise in bulb wall temperature. The more heavily loaded rapid start lamp, however, with its inherently higher bulb wall temperature, requires better air circulation than the slimline lamp in order to limit rise in bulb wall temperature. Comparing the efficiencies of industrial units, Table II, it would appear both the slimline and rapid start lamps are operating at comparable bulb wall temperatures. The use of slotted reflectors increases efficiency primarily due to release of trapped light but the rapid start and slimline lamps still compare favorably in efficiency in similar units. In commercial luminaires a noticeable drop in efficiency (Table V) occurs when using the rapid start lamp. In the direct-indirect type unit, the louver and side panel construction restrict air circulation, while in the case of the bare lamp unit, the lamps are so close together and

TABLE VI — Cost of Lighting Analysis for Typical Commercial Area of 2500 Square Feet. Room Index of "C." To Provide 50 ft-c Maintained.

	LIGHTING SYSTEM NUMBER	I	II	I	II	I	II
DESCRIPTION OF LIGHTING SYSTEMS	1. Type of lamp (fil., merc., preheat fluor., slimline, etc.	Slimline	Rapid Start	Slimline	Rapid Start	Slimline	Rapid Start
	2. Lamp description	F96T12/CW	F96T12/RS/CW	F96T12/CW	F96T12/RS/CW	F96T12/CW	F96T12/RS/CW
	3. Type of luminaire	Direct-Indirect 30° Louver Shielding		Semi-Indirect Plastic Bottom		Bare Lamp Strip	
	4. Number of lamps per luminaire	4		2		2	
BASIC DATA	5. Rated initial lamp lumens per luminaire	20,200	29,000	10,100	14,500	10,100	14,500
	6. Lamp life	7500		7500		7500	
	7. Watts per luminaire (including auxiliary)	366	490	183	245	183	245
	8. Coefficient of utilization RI = C Refl. 80% 30%	0.59	0.57	0.44	0.39	0.67	0.64
	9. Maintenance factor: Good	0.70		0.70		0.70	
	10. Number of luminaires	15	11	40	32	26	19
	11. Average footcandles maintained	50		50		50	
	12. Energy rate ($ per kwh)	$ 0.02		0.02		0.02	
	13. Estimated burning hours per year	2000		2000		2000	
INITIAL COST	14. Net luminaire cost (each)	$ 48	56	27	32	17	22
	15. Net additional accessory cost per luminaire	$ 2.00	2.00	2.00	2.00	0.50	0.50
	16. Estimated wiring & installation cost per luminaire	$ 30	35	18	20	23	26
	17. Net initial lamp cost each (list less 30%)	$ 2.45	2.70	2.45	2.70	2.45	2.70
	18. Net initial lamp cost per luminaire (4×17)	$ 9.80	10.80	4.90	5.40	4.90	5.40
	19. Total initial cost per luminaire (14+15+16×18)	$ 89.80	103.80	51.90	59.40	45.40	53.90
	20. TOTAL INITIAL COST (10×19)	$ 1,347	1,142	2,076	1,901	1,180	1,024
ANNUAL FIX. CHG.	21. Initial cost per luminaire less lamps (14+15+16)	$ 80.00	93.00	47.00	54.00	40.50	48.50
	22. Total initial cost less lamps (10×21)	$ 1,200	1,023	1,880	1,728	1,053	922
	23. ANNUAL FIXED CHARGES (15%† of 22)	$ 180	153	282	259	158	138
ANNUAL OPERATING COSTS	24. Annual no. lamp replacements (4×10×13÷6)	16	12	21	17	14	10
	25. Annual cost of replacement lamps (17×24)	$ 39.20	32.40	51.45	45.90	34.30	27.00
	26. Annual cost of replacement parts (starters, etc.)	—	—	—	—	—	—
	27. Total annual maintenance material cost (25+26)	$ 39.20	32.40	51.45	45.90	34.30	27.00
	28. Estimated labor cost to replace one lamp	0.75		0.75		0.75	
	29. Total labor cost to replace lamps (24×28)	$ 12.00	9.00	15.75	12.75	10.50	7.50
	30. Estimated cleaning cost per luminaire	$ 2.50		1.50		0.75	
	31. Number of cleanings per year	Two		Two		Two	
	32. Annual cleaning cost (10×30×31)	$ 75.00	55.00	120.00	96.00	39.00	28.50
	33. Total annual maintenance labor cost (29+32)	$ 87.00	64.00	135.75	108.75	49.50	36.00
	34. Total Annual Maintenance Cost (27+33)	$126.20	96.40	187.20	154.65	83.80	63.00
	35. Annual Energy Cost (7×10×12×13÷1000)	$ 220	215	293	314	190	186
	36. TOTAL ANNUAL OPERATING COST (34+35)	$ 346	311	480	469	274	249
TOTAL AND REL. COSTS	37. TOTAL ANNUAL COST (23+36)	$ 526	464	762	728	432	387
	38. Relative Annual Cost	113%	100%	105%	100%	112%	100%
	39. Annual Cost per Footcandle (37÷11)	$ 10.52	9.28	15.24	14.56	8.64	7.74
	40. Relative Annual Cost per Footcandle	113%	100%	105%	100%	112%	100%

*Usually 15 per cent, assuming 10-year amortization with 5 per cent allowance for taxes, insurance and interest.

mounted right below the channel so as to again restrict circulation. The more heavily loaded rapid start lamp, therefore, will tend to exceed optimum bulb wall temperature to a greater extent than the slimline lamp. This becomes even more evident when, in the case of the semi-indirect unit, a solid plastic bottom restricts circulation even more.

Coefficients of utilization were calculated, according to the IES currently preferred method,[5] for the three luminaires tested. Due to the lower efficiencies of the rapid start luminaires compared to similar slimline luminaires, the new coefficients were lower.

Economic Comparison

The cost analysis in Table VI is a comparison of commercial luminaires using either the rapid start lamp or the slimline lamp. The basic assumptions in its derivation are an energy rate of $0.02 per kilowatt hour, 2000 burning hours per year, and an amortization period of 10 years for equipment cost. Selected for this analysis is an area of 2500 sq ft, with a room index of C, and a maintained illumination level of 50 footcandles.

From line 20, Total Initial Cost, the substitution of the rapid start lamp in all three types of luminaires results in slightly lower initial cost. Since fewer rapid start units are required, Total Annual Maintenance Cost, line 34, shows additional savings for the rapid start unit. Line 35, Annual Energy Cost, shows almost equal energy cost for comparable direct-indirect luminaires and direct type luminaires. In the comparison of semi-indirect luminaires, however, the rapid start unit has a higher energy cost than the slimline. The reduction in luminaire efficiency when using rapid start lamps has resulted in almost equal installed wattage for the direct-indirect and direct type units and in the case of the semi-indirect unit, additional wattage with rapid start is required to furnish the same illumination as with slimline. Line 38, Relative Annual Cost, although still favoring rapid start, is not as favorable as it was in the industrial analysis. In fact, in the case of the semi-indirect comparison, relative cost approaches a toss-up between rapid start and slimline.

Conclusions

These preliminary investigations into the use of high output rapid start fluorescent lamps in presently available commercial type luminaires, are not particularly encouraging. Only in suspended type units does direct substitution seem possible and even then in some cases, luminaire redesign is indicated before real savings can be achieved. This redesign problem will be primarily one of adequate shielding without reducing air circulation to the extent of suffering excessive loss in light output from high lamp bulb wall temperatures. This same problem will be encountered with recessed and surface mounted luminaires in addition to the lowering of ballast temperature to conform with Underwriters' Standards. For a quality lighting installation, the cost advantage of high output rapid start lamps is offset by their higher brightness when used in standard units.

The integration of the high output rapid start lamp for industrial lighting seems more practical and economical. Present industrial luminaires are adequate, performance wise, for immediate use. At lower mounting heights, care must be exercised to provide adequate shielding. The increased use of better quality fluorescent lighting is now economically justified at higher mounting heights.

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2. Calculating Coecients of Utilization, ILLUMINATING ENGINEERING, Vol. LI, No. 5, p. 385 (May 1956).
3. IES Guide for the Photometric Testing of Fluorescent Luminaires, ILLUMINATING ENGINEERING, Vol. XLIV, o. 7, p. 413 (July 1949).
4. Diefenthaler, R. J., and Forbes, J. C.: "Effect of External Factors on Light Output of Fluorescent Sources." ILLUMINATING ENGINEERING, Vol. XLI, p. 872 (December 1946).
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DISCUSSION

WILLARD ALLPHIN:* In this useful paper the author is to be commended for going beyond the usual practice of computing cost based upon a particular set of circumstances. He has shown how these costs will vary with changes in certain elements of the situation. This should make it easier to fit the calculations to other examples.

It might be mentioned that high-output lamps should prove particularly useful in cove lighting installations where lumens per running foot are more important than efficiency.

J. J. NEIDHART:** This paper contains the kind of useful information that we all need to help us apply new light sources. I would like to thank Mr. Johnson for preparing the data and making it available to us. There are a few points, however, which I believe require discussion to prevent possible misinterpretation of the data.

It seems very appropriate to include fluorescent mercury lamps in the economic comparisons since the 800-ma lamp will probably be used most extensively in medium height (14-30 ft) industrial areas where the fluorescent mercury lamp has often been our most economical source. On the other hand, it is important that we call attention to the fact that there are factors to be considered other than relative economy. Fluorescent mercury lighting systems are not directly comparable to fluorescent lighting in that they do not provide illumination of comparable quality. The lower brightness of fluorescent lamps, even when operated at 800

*Sylvania Electric Products Inc., Salem, Mass.
**The Miller Co., Meriden, Conn.

milliamps, enables us to obtain more comfortable lighting installations with properly shielded equipment, and it minimizes the problem of reflected glare from polished or shiny metal surfaces. The larger area and diffuse qualities of fluorescent lighting equipment are also advantageous from the standpoint of shadow reduction and illumination on vertical surfaces. Mercury lamps also have another disadvantage in that they are subject to outages from voltage dips of 15 per cent or more and will not restart immediately after such a dip or power failure. As a safety measure, it is usually desirable to provide some standby incandescent lighting along with the mercury system, and this incandescent lighting will tend to make the mercury system slightly less economical.

For good reasons, Mr. Johnson avoided reference to specific mounting heights; but since he has indicated apparent economic advantages for narrow distribution fluorescent mercury systems, I believe that specific mounting heights must be brought into the picture. It is possible to demonstrate that, for the conditions shown in his cost studies, the narrow disribution fluorescent mercury units could not be installed at mounting heights of less than 20 feet and still obtain acceptable illumination uniformity. This means that these mercury units should not even be considered for 14-20-ft mounting height applications regardless of any apparent economic advantage which his cost analysis may show.

I do not mean to imply from these remarks that the 800-ma lamp and the new higher output fluorescent sources will make mercury lighting obsolete. Mercury lamps are still one of our more valuable lighting tools, and there are and will continue to be many applications where mercury lighting is the best thing that we can recommend. My objective in the above discussion is merely to point out that there are many factors that must be considered in selecting a light source for a given application, that economics is only one of these factors, and that economic comparisons by themselves can sometimes be misleading.

Although the 800-ma and the newer high output sources will doubtless find some commercial application in luminous ceilings, coves, stores with high ceilings, and in exceptionally well-shielded equipment, it is interesting to note that the 800-ma lamp has no real economic advantage in conventional semi-indirect luminaires. This should eliminate it from consideration in such equipment since the use of the 800-ma lamp will also result in higher luminaire and ceiling brightnesses than would be obtained with the 425-ma lamps.

The temperature problems which were discussed in this paper deserve our attention and point up the need for all of us to use these higher output fluorescent sources with discretion and considerable care. We must be certain that we use such lamps in equipment that is designed for them and that we apply the equipment in such a way that we won't run into excessive ballast failures or severe reductions in light output due to operation at materially higher than optimum temperatures. The indications thus far are that we should be very wary of the use of these lamps in surface-mounted and recessed lighting equipment unless assurance can be given that the lamps have been tested in such equipment under operating conditions and the results indicated satisfactory operation.

It is an unfortunate characteristic of our industry that, whenever a new light source is introduced, we often go through a period of misuse and abuse of that source. I am glad to see this paper, because I believe that the information which Mr. Johnson has given us should help us prevent much of that misapplication.

MILES PENNYBACKER:* Mr. Johnson has assumed a maintenance factor of 70 per cent for all of the fluorescent lamps. This overlooks the well-known rule which I think was first given by Dr. Lowry, that the light depreciation varies with the watts per unit area. Now the 850-milliamp rapid-start lamp has roughly 35 per cent more watts per unit area than the 430-milliamp slimline. Therefore, I would expect that the light depreciation from the higher output lamp would be considerably more rapid. Since the paper is based on 50 footcandles maintained, it would seem to me that the author would have to make allowances for that by increasing the number of luminaires, increasing maintenance, and increasing the power output correspondingly, which would make it less advantageous on industrial and certainly much more doubtful in commercial applications.

That brings up one more point that was just touched on by a previous speaker in his comments: The question of lamp temperature and its effect not only on immediate lamp efficiency, but on lumen maintenance. There is room for further investigation on that. So far as I know, it has not been published. We know what the effect of watts per unit area is for ordinary ambient temperature, but how is the increased ambient temperature in these various fixture applications of high output lamps going to affect depreciation? I don't think we have had published data. But, there's every reason to believe, since most chemical and physical processes are more rapid at increased temperatures, that the lumen depreciation may be even more rapid than is indicated by the customary use of Dr. Lowry's formula.

E. A. LINSDAY:** This cost study, like all others, of course, is subject to discussion on details of the assumptions that have been made and I think, generally speaking, they have been well handled. It follows the well-established method of cost analysis presented to I.E.S. in 1951. There are two or three points which I think might deserve more careful attention. One problem in some of these comparisons between types of fluorescent lamps and fluorescent to mercury is the actual lumen output in service which the system delivers. The 96T12 rapid start lamp, for example, is rated 105 watts and 7300 lumens. I wonder what the actual value in service on commercially available ballasts is and if it is the same percentage of the rated value with the rapid start lamps that it is with slimline. In many cases this is not true.

One other point on the actual efficiency comparisons between the two sources. In Table I, the rapid start lamp is listed as 59.2 lumens per watt overall efficiency, the slimline 55.2. That is quite a difference in favor of the rapid start. That, I think, should be also checked carefully because, generally speaking, slimline lamps have been fully as efficient in the same color as the rapid start lamps under service conditions. Then, a later slide showed a higher energy cost for the rapid start installation over the slimline installation, which would tend to confirm the fact that the rapid start is lower in overall efficiency than the slimline.

Actually, the overall conclusions of the paper are, I felt, a little more negative than they need be. The redesign requirements can be handled reasonably well in most cases, and satisfactory installations can be produced, at least from the direct glare standpoint, with relatively minor redesign of the lighting equipment. One further point is that in comparing fluorescent to mercury, as is done here, fluorescent is obviously more comfortable than a mercury system,

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**General Electric Co., Nela Park, Cleveland, Ohio.

and in those areas where the mercury might be used, fluorescent is a step forward in comfort. The addition of a table showing relative comfort of the various systems would have been helpful.

In conclusion, there certainly have been a great number of installations of this rapid start lamp both in industrial and commercial installations. They have worked out very well and have been rated as quite comfortable and quite acceptable. I would expect a rather wide application of the source from here on out and a substantial advantage cost-wise. They are shown pretty much as a stand-off in this paper. Most of our calculations give 5 to 10 per cent advantage for the rapid start in overall cost of light. I have just heard of a new store lighting installation in Chicago of 100 footcandles provided by 24-inch wide 4-lamp recessed troffers. This is working out very well and is rated as highly comfortable. So I think this new source can be looked at more positively than was the impression that I got, particularly from reading the paper.

R. D. BRADLEY:* I have one positive and one negative and the timer says I can have one minute, so it comes out even.

The positive thing that I wanted to bring up was that one may get the impression, from the little curve on the temperature of ballasts (Fig. 4), that it was impossible to develop a two-lamp troffer in which the ballast could be used. That is not so. We have definitely developed a two-lamp glass enclosed troffer in which the high-intensity ballast can be used. I will say right offhand, however, that you cannot do it without a lot of special equipment around the ballast.

The noise angle was not brought out at all in this paper. I think that we should mention as the negative aspect of this application that noise ratings on this ballast are up near the top of the noisier group. Now, of course, in a great many installations such as stores, this is of relatively little importance. However, I am sure that all of you have been in places where it is of much greater importance than might be indicated from this paper. You could get into a lot of trouble with it.

BILL F. JONES:** Since the advent of the 800-ma lamp, a large amount of testing of the lamp's characteristics and uses has been done at my company. In the process we have duplicated nearly all of Mr. Johnson's tests and calculations. In nearly every case our results agree extremely well. The results of his temperature tests in particular are almost identical with those we obtained, and his conclusions on ventilated industrial fixtures and on surface mounted or recessed commercial fixtures are identical with those we had reached. Also, numerous cost comparisons of industrial lighting systems we have made agree within close limits with those of Mr. Johnson.

There are two conclusions reached, however, which are at variance with our experience. One concerns the relative efficiency of a totally direct industrial fixture when equipped with slimline and with rapid start lamps. In one test we took a standard, open-end slotted industrial fixture with 800-ma lamps, measured the light output, then blocked up the slots so they would not transmit hot air. We then let the fixture restabilize and noted the drop in efficiency. We found a drop in light output from the *lamps* (not the fixture) of 8 per cent due to the removal of ventilation. A similar test with 430-ma lamps showed a drop of 3 per cent. These tests were performed at an 80° F ambient, with the temperature controlled to within plus or minus ½ degree. A repeat test on the rapid start at an 85° F ambient showed a 15 per cent drop in light output. This indicates that for proper efficiency ventilation of the 800-ma lamp is an absolute must. Also, the ballast ran hotter in the non-ventilated fixture. We have, therefore, been recommending that 800-ma lamps not be used in totally direct (non-ventilated) industrial fixtures.

We feel also that Mr. Johnson has been unduly pessimistic about the use of the 800-ma lamp in commercial fixtures, particularly the semi-indirect type. The most successful commercial fixture we manufacture happens to be of this type, and is in my mind an excellent example of what can be done in this field with the 800-ma lamp. The fixture has the same efficiency with slimline and rapid start lamps — 78 per cent. This was accomplished because we gave great attention to the temperature problem for both lamps and ballast, providing ample ventilation for the former and locating the latter away from the lamps to keep both lamps and ballast cool. The unit is described in detail in the November 1956 issue of I.E. (First Prize, My Most Interesting Lighting Job Contest), to which reference may be made for an example of how a successful commercial design can be carried out using the 800-ma lamp.

Since our experience with efficiency does not agree in the case of the semi-indirect fixture, our cost comparisons for this type do not agree with those advanced by Mr. Johnson either. As a matter of fact, we have found in actual practice that the iniial cost of a semi-indirect system of this type in rapid start is on the average 20 to 25 per cent less than that for the same level with slimline. Due to the higher efficiency of the 800-ma lamp, the power consumption and thus the operating costs are also somewhat lower. Finally, since there are approximately 30 per cent fewer lamps and fixtures to maintain, the maintenance costs are also considerably lower.

Due to the high brightness of the lamp, we agree that its use in commercial designs in which the lamp is exposed, such as louvered or clear lensed units, must be approached with caution. Such designs would most probably not be applicable to office or school lighting, but might be eminently suitable for store lighting.

Our feeling is, therefore, that while most present commercial designs are not readily adaptable to the 800-ma lamp, still proper recognition of the temperature and brightness characteristics can lead to successful designs in the commercial field.

*Day-Brite Lighting Inc., St. Louis, Mo.
**Smoot-Holman Co., Inglewood, Calif.

INSTALLATION AT
SUNSET PHARMACY
MAIN ST.
POTTSTOWN, PA.

Lighting a Drug Store

LIGHTING OBJECTIVE: To provide a high quality of general illumination for an attractive environment in the sales and prescription areas of a drug store.

GENERAL INFORMATION: The irregular area shown above is approximately 50 feet by 53 feet. The height from floor to plastic is 10 feet. The height to the ceiling is 12 feet. Colors and reflectances are as follows: ceiling, white, 80%; left wall, gritan yellow, 19%; right wall, nile green, 23%; back wall, red bird, 28%; front wall, glass; floor, coral and brown, 35%; furniture, blond, 40%.

INSTALLATION: One hundred and eight 96-inch single lamp channels, Benjamin catalog No. 251196 are mounted above the plastic luminous ceiling, Benjamin Panel-Glo, in continuous rows. The channels, each of which is equipped with one 96-inch T-12 standard cool white slimline lamp operated at 430 ma, are surface-mounted and spaced approximately on 3-foot centers.

The average general illumination was measured as 95 footcandles. Brightness readings at that time were as follows: luminous ceiling, 137 ft-L; left wall, 7.6 ft-L; right wall, 9 ft-L; back wall, 11 ft-L; floor, 30 ft-L; furniture, 38 ft-L.

Lighting designed by M. N. Flynn, Benjamin Electric Mfg. Co., and T. H. Gallagher, Philadelphia Electric Co., Philadelphia, Pa.; electrical contractor, William Fosnocht, 367 Walnut St., Pottstown, Pa.

Lighting data submitted by M. N. Flynn, Benjamin Electric Mfg. Co., District Representative, Gloucester, N. J., George C. Linthicum and George T. Anderson, Jr., Philadelphia Electric Co., Philadelphia, Pa., as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

Series XXI 12-56

A.I.A. File No. 31

Among the numerous duties specified for the General Secretary in the Constitution is the requirement that he prepare annually a report for publication in the designated official publication, ILLUMINATING ENGINEERING. This report, based on material received from the Officers, Committees, and Sections and Chapters, has been assembled with the assistance of the staff at headquarters. A preview of certain phases of this report was presented at the opening session of the National Technical Conference in Boston, September 17, 1956.

The General Secretary Reports

By GEORGE J. TAYLOR

Membership

Statistics — Table I of this report shows the present membership of the Society compared with figures at the conclusion of each of the past five fiscal years. These figures continue to show a growth in the major membership classifications. The growth of the Society's membership since 1906 is shown graphically in the curves of Fig. 1.

Table II of this report records the gains and losses for the year and the general accounting of changes in all grades of membership. The over-all net increase of 302 brings the total membership of the Society to 8,480. Table III records the Society membership by Sections and Chapters divided according to grade of membership.

Members Emeritus, Fellows, Honorary Members — The Constitution of the Society specifies three grades of membership designed to recognize Members who have made contributions to the activities of the Society and to the general field of illuminating engineering. This year action was taken by Council naming as Members Emeritus four who performed for the Society services of such meritorious character as Council deemed worthy of this honorable reward. They are:

Horn, Caroline E., New York Section
Randall, W. C., Michigan Section
Watson, L. M., Southern California Section
Williams, Samuel B., New England Section

Based on their valuable contributions to the technical activities of the Society and to the science or art of illumination, ten Members of the Society were recommended by the Board of Fellows and were approved by Council. They are:

E. A. Anderson
E. H. Church
G. F. Dean
G. K. Hardacre
G. A. Horton
B. J. Jensen
C. H. Laupp
D. Nickerson
G. F. Prideaux
M. N. Waterman

For the first time since 1931, action was taken by the Council to name an Honorary Member — Doctor Irving Langmuir, Nobel Prize Winner and for many years associated with the General Electric Research Laboratories at Schenectady, New York.

Deceased — The Society records with sorrow the death of two Members Emeritus, 13 Members and 30 Associate Members during the fiscal year.

Members Emeritus

Crittenden, E. C.
Gage, Henry Phelps

Members

Grattan, Harry, Jr.
Hines, S.
Jalonick, Hartwell
Koch, Karl M.
Leishman, B. H.
McCall, Bruce I.
Miller, Clifford
Nelsen, Andrew G.
Nutt, Marshall D.
Putnam, G. J.
Shildroth, Arthur E.
Siebs, C. T.
Steele, Robert E.

TABLE I — Membership as of September 30.

	1951	1952	1953	1954	1955	1956
Members Emeritus	32*	34*	32*	34*	35*	37*
Fellows	42	41	70	78	89	99
Members	1,709	1,797	1,870	1,939	1,979	2,123
Associate Members	5,174	5,293	5,579	5,621	5,887	6,036
Student Members	209	229	244	230	188	185
Total	7,166	7,394	7,795	7,902	8,178	8,480
Fellows of the Society included	*10	*11	*12	*12	*12	*10

TABLE II — Gains and Losses in Membership During Year Ending September 30, 1956.

	Members Emeritus	Fellows	Members	Associate Members	Student Members	Total
October 1, 1955	35	89	1,979	5,887	188	8,178
Gains						
Elections			123	925	97	1,145
Reinstatements			39	85	1	125
Transfers	4	10	107	7		128
Total Gains	4	10	269	1,017	98	1,398
Losses						
Resignations			59	334	43	436
Dropped			40	396	51	487
Deceased	2		13	30		45
Transfers			13	108	7	128
Total Losses	2		125	868	101	1,096
Net Change	2	10	144	149	−3	302
Total Membership as of September 30, 1956	37*	99	2,123	6,036	185	8,480

*Includes 10 Fellows.

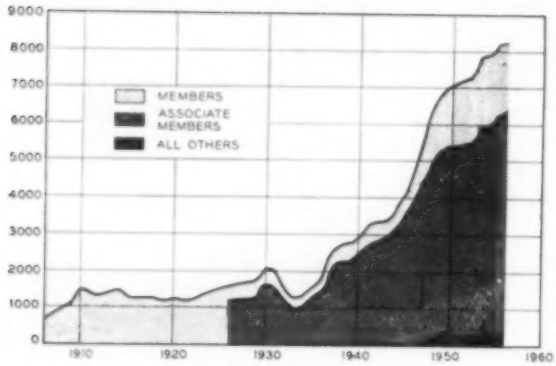


Figure 1. Membership. Total. Members, Associate Members, all others.

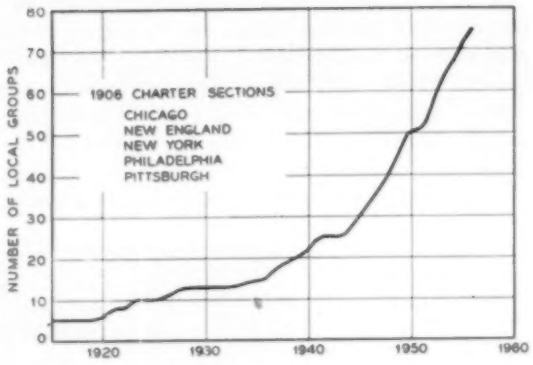


Figure 2. Growth of Sections and Chapters.

Associate Members

Ainsworth, Forester F.	Maddox, E. N.
Burdick, John T.	Merrill, John B.
Davidson, Alex	Miltenberg, A. M.
Ernesty, Ernest	Moore, Walter C.
Fats, John H.	Nelson, Griffin Thomas
Goodale, Samuel Perley	Puckett, Emroy L.
Hancock, John V.	Robinson, R. R.
Hanan, Lucy Lucile	Schultis, John J.
Johnston, Wilbur B.	Scott, Harry L.
Kline, L. A.	Tonsor, M. J.
Kohlroser, Vincent	Warfel, Joseph L.
Langmack, Carl J.	Warffuel, Ro
Lerten, Benjamin A.	Welty, Paul H.
Liversidge, Horace P.	Williams, H. M.
Lothamer, Russell L.	Willis, Thos. Alexander

Regional Activities

Committee Program — The Committee, which consisted of the ten Regional Vice-Presidents, and headed by Kirk M. Reid, Vice-President of the Society, accomplished an ambitious year-long program of coordinating and assisting the activities of the Regions and the constituent Sections and Chapters. The Committee held regular meetings on the day before Council meetings and some of these required extra special sessions to cover all items in the lengthy agenda. Between meetings, the work of the Committee was advanced through a series of nineteen communications, including official Minutes, and each of the Regional Vice-Presidents used this means for maintaining contact with and informing his Sections and Chapters. Considerable assistance was given several of the other national committee programs through the year, both by the presence of National Officers and National Committee Chairmen at this Committee's meetings, as well as by special efforts in each Region. These included Publications, National Technical Conference, Membership, Sustaining Membership, Public Relations and Information, and the Golden Anniversary.

A major step was taken in solving the problems inherent in the large-sized Southern Region which included all, or parts, of ten states, and a total of twelve Sections and Chapters. Following intensive study, and consideration at the local level, Council approved the Committee's recommendation dividing the Southern Region into two new Regions, composed as follows:

Southeastern

Florida Section
Georgia Section
Palmetto Chapter
Southeast Florida Chapter
Suwannee River Chapter
Tar Heel Section

South Central

Alabama Section
Arkansas Chapter
Mid-South Chapter
Mississippi Chapter
New Orleans Section
Tennessee Valley Section

A number of important subjects were studied during the year by project subcommittees, each of these producing a report, in some instances including recommendations to the Council. The seven completed study projects included Travel Budgets (to aid in travel to constituent local group meetings), Solicitation of Funds at the Regional Level, Local Activities Meetings (held in conjunction with regional conferences), Visits to Sections and Chapters, Method of Nomination of National and Local Officers, National Membership Directory, Assistant to the Regional Vice-President.

The Committee concluded its year in a meeting in Boston after the Conference, jointly with the new administration's committee. At this meeting, a number of additional projects were passed along to the new committee for consideration in the coming fiscal year.

Section and Chapter Programs—The 75 Sections and Chapters of the Society all carried out programs of service through organization of their local memberships and committees. According to reports received at headquarters, over 600 regular and special meetings were held during the year, mostly on a monthly basis, with an attendance of members and guests of over 30,000. The scheduling of speakers and subjects for these meetings provides the

New Chapters Established by Council Action During 1955-1956.

No.	Chartered by Council Action	Name	Headquarters City	Region	Charter Officers
72	10/13/55	Panhandle	Amarillo, Texas	Southwestern	C. R. McCracken, Chairman Jack Poynter, Secretary
73	6/14/56	Edmonton	Edmonton, Alberta	Pacific No. West	J. E. Bagshaw, Chairman E. T. Linney, Secretary
74	6/14/56	Yankee	Springfield, Mass.	Northeastern	A. C. Brodeur, Jr., Chairman B. D. Barry, Jr., Secretary
75	6/14/56	Chinook	Calgary, Alberta	Pacific No. West	Don Frost, Chairman Donald Little, Secretary

Chapter Elevated to Section Status by Council Action During 1955-1956.

Council Action	Name	Headquarters City	Region
2/9/56	Alabama	Birmingham	South Central

largest opportunity for direct participation by the membership in the Society program.

A large number of the local groups operated, as a regular part of their local program, a study club or technical forum offering the more detailed discussion of the technical aspects of illuminating engineering.

Residence Lighting Forums continue to be an important activity of eight of the Society's Sections: Chicago, Georgia, Michigan, New York, St. Louis, Twin City, Tennessee Valley and Utah. Regular monthly meetings were scheduled by most of the Forums, with discussions and demonstrations conducted by their own members and prominent men and women of the lighting industry and allied fields.

Operating under the revised Guide prepared by the Lighting Service Committee 49 of the Sections and Chapters scheduled "Most Interesting Lighting Job" Contests. Winners in the local contests, which provided unusually fine local programs, went into the Regional Conference competitions.

Student Branches—During the year, four of the Society's Student Branches continued active and four were inactive. No new Branches were formed during the year. Regular meetings and programs were operated by the Student Branches at:

Oregon State College
University of Illinois
Southern College of Optometry
University of Miami

Regional Conferences—Nine Regional Conferences were held. A Regional Conference was not scheduled in the Northeastern Region because of the planning for the National Technical Conference in Boston. All Sections and Chapters cooperated in the organization of the Regional Conferences and there was representation at the Conferences from a large proportion of the Sections and Chapters of the Society. The Conferences continued to maintain high standards of excellence in their programs and in the performance of the respective Conference Executive Committees. The summary of the Conferences with the principal officers in charge follows:

Canadian Regional Conference, May 17-18, 1956, Chateau Frontenac, Quebec, Que., H. R. Payson, Chairman, Tri-Bec, Inc.

East Central Regional Conference, May 24-25, 1956, Shoreham Hotel, Washington, D. C., Benjamin Goodman, Chairman, National Electric Wholesalers.

TABLE III — Membership of Sections and Chapters as of September 30, 1956.

	Members Emeritus	Fellows	Members	Associate Members	Student Members	Total
CANADIAN REGION						
Blue Nose Chapter			12	24		36
Hamilton, Ontario Chapter			6	25		31
Maritime Chapter			4	44		48
Montreal Section			37	79		116
Ottawa Chapter			12	28		40
Quebec Chapter			7	24		31
Toronto Section		4	45	176		225
Winnipeg Chapter			5	40		45
EAST CENTRAL REGION						
Capital Section		6	39	54	1	100
Eastern Pennsylvania Section	1		40	107		148
Maryland Section		1	25	46		72
Philadelphia Section	1 (1 F)	4	80	188		273
Pittsburgh Section		1	62	145	2	210
Virginia Chapter	1		22	29	1	53
GREAT LAKES REGION						
Central New York Section		3	34	96	1	314
Cleveland Section	6 (2 F)	27	95	232	1	361
Miami Valley Chapter		1	15	39	1	56
Michigan Section	2	3	66	194	7	272
Northwestern Ohio Section			20	48		68
Ohio Valley Section			28	68	1	97
Rochester Section		1	13	71		85
Western Michigan Section			16	42		58
Western New York Section			10	79	2	91
INTER-MOUNTAIN REGION						
Arizona Section			17	62		79
New Mexico Chapter			4	29	2	35
Rocky Mountain Section			16	50	1	67
Southern Colorado Chapter		1	10	16		27
Utah Section			23	40		63
MIDWESTERN REGION						
Central Illinois Chapter			12	38		50
Chicago Section	6 (3 F)	6	130	376	20	538
Cornhusker Chapter			15	65	2	82
Heart of America Section			29	86		115
Indiana Section			31	80	6	117
Iowa Section			21	67	1	89
Milwaukee Section		2	34	167	5	208
St. Louis Section		2	34	169	3	208
Twin City Section			24	173	2	199
Twin Ports Chapter			6	27		33
NORTHEASTERN REGION						
Connecticut Section	3 (1 F)	3	38	119	1	164
Eastern New York Section	3 (1 F)	1	16	58		78
New England Section	2	7	82	232	1	324
New York Section	2	14	182	342	4	544
Yankee Chapter			14	36		50
PACIFIC NORTHWEST REGION						
British Columbia Section			23	45		68
Chinook Chapter			6	15		21
Edmonton Chapter			7	32		39
Inland Empire Chapter			11	46		57
Oregon Section	1		31	69	13	114
Puget Sound Section			27	80	1	108
Vancouver Island Chapter			4	19		23
SOUTH CENTRAL REGION						
Alabama Section			21	49		70
Arkansas Chapter			4	24	1	29
Mid South Chapter			9	20	52	81
Mississippi Chapter			7	22	2	31
New Orleans Section			20	61		81
Tennessee Valley Section			22	49		71
SOUTHEASTERN REGION						
Florida Section	2 (1 F)	1	17	78	2	99
Georgia Section			56	76	2	134
Palmetto Chapter			14	36	1	51
Southeast Florida Chapter			10	47	14	71
Suwannee River Chapter			19	35	1	55
Tar Heel Section		2	36	91	4	133
SOUTH PACIFIC COAST REGION						
Golden Gate Section	1	2	65	222	3	293
Mother Lode Chapter			14	22		36
San Diego Chapter	2	1	23	36		62
San Jose Chapter		1	9	17	1	28
Southern California Section	2 (1 F)	2	81	240	14	339
SOUTHWESTERN REGION						
Alamo Chapter		2	16	52	1	71
Ark-La-Tex Chapter			10	28		38
Central Oklahoma Chapter			6	35	1	42
Oil Capital Section			19	34	1	54
Panhandle Chapter			7	27		34
San Jacinto Section			16	44	1	61
Southwestern Section		1	31	93		125
Foreign non-Section	2	1	47	52	5	207
Mexico Chapter			4	30		34
TOTAL	37	99	2,123	6,036	185	8,480

Great Lakes Regional Conference, May 7-8, 1956, Commodore Perry Hotel, Toledo, Ohio, Robert Taylor, Chairman, Toledo Edison Co.

Inter-Mountain Regional Conference, April 26-28, 1956, Utah Hotel, Salt Lake City, Utah, J. Homer Shaw, Chairman, Utah Power & Light Co., A. E. Fleming, Co-Chairman, General Electric Supply Co.

Midwestern Regional Conference, May 10-11, 1956, Severin Hotel, Indianapolis, Ind., Denton E. Hall, Chairman, C. M. Buck and Associates.

Pacific Northwest Regional Conference, April 19-21, 1956, Davenport Hotel, Spokane, Wash., John Ruffatto, Chairman, Columbia Electric & Mfg. Co.

Southern Regional Conference, April 5-6-7, 1956, Thomas Jefferson Hotel, Birmingham, Ala., W. J. Pettyjohn, Chairman, Westinghouse Electric Corp.

South Pacific Coast Regional Conference, April 12-13, 1956, Mark Hopkins Hotel, San Francisco, Calif., J. E. Barnes, Chairman, Pacific Gas & Electric Co.

Southwestern Regional Conference, April 8-10, 1956, Hilton Hotel, Fort Worth, Texas, L. T. Anderson, Chairman, Texas Electric Service Co.

Local Representatives—With the cooperation of the Regional Vice-Presidents, the Sections and Chapters again recommended the appointment of local represenatives to carry on the work of the Society in areas not served directly by the local programs of Sections and Chapters.

Finance

The committee, with W. Warren Booth, Chairman, continued its direct supervision of the financial affairs of the Society, as charged in the articles of the Constitution.

The committee's work included, as usual, the preparation of an operating budget and its presentation for Council adoption at the October meeting. This included a careful review of the requests from all Sections and Chapters for budget allotments for the year.

The committee also presented to the October and December Council meetings reports resulting from three years of study on the subject of life membership (later changed to Retired Membership).

The Society's investment program was reviewed throughout the year and related actions were taken as Council approved the investment of funds transferred to the reserve.

The committee also reviewed and recommended for Council approval the financial reports for the 1955 National Technical Conference and the proposed budget for the 1956 National Technical Conference.

Careful study was given the requests for special appropriations during the year, and as a result, approval of Council was recommended for allotments of $4,000.00 under the Golden Anniversary, $5,000.00 in connection with Headquarters renovation, and $500.00 for providing a newly designed pin for Past Presidents.

The Annual Report on the Society's financial condition was presented to Council at the February meeting in conjunction with the Treasurer's Annual Report.

Fiscal Year Statements—The official financial statements for the year are provided as part of the auditor's report, including the income, expense statement, and the balance sheet. The

Statement of Income and Expense for the Year Ending September 30, 1956

INCOME

Annual Dues		
Fellows	$ 1,365.00	
Members	30,204.06	
Associate Members	76,254.60	
Student Members	785.37	
Entrance Fees	2,684.00	$111,293.03
Sustaining Members		63,893.25
Sales, Publications, Gross		
IES Lighting Handbook, 2nd Edition	6,961.80	
Lighting Data Sheets	3,310.59	
Reprints	10,088.33	
ILLUMINATING ENGINEERING	12,455.84	
National Technical Conference Preprints (1955)	1,241.25	
Membership Roster	2.00	34,059.81
ILLUMINATING ENGINEERING, Advertising		194,734.96
Sales, Badges and Certificates, Gross		1,041.95
Investments		3,575.98
1956 National Technical Conference Income	20,383.00	
Less: Expense	18,351.80	2,031.20
Miscellaneous		5.54
TOTAL INCOME		$320,635.72

EXPENSE

General*		$ 11,406.18
Office, Business	$ 53,267.09	
Office, Technical	38,103.24	
Office, Publications	45,116.98	136,487.31
Organization, Committees**	8,788.99	
Sections and Chapters	26,915.57	
President's Travel	4,000.00	39,704.56
Sales, Badges and Certificates		804.73
Depreciation, Publications Stock***		254.61
ILLUMINATING ENGINEERING to Membership		69,260.63
Sales, Publications, Cost of Stock		
IES Lighting Handbook, 2nd Edition	1,865.50	
Lighting Data Sheets	1,316.84	
Reprints	5,008.91	
ILLUMINATING ENGINEERING	8,083.47	
National Technical Conference Preprints (1956)	1,232.80	17,507.52
Sales, Publications, Stock, Services, Sales and Advertising Promotion		9,843.40
Retirement Pension Plan		4,964.93
Federal Social Security Tax		1,408.05
To I.E.S. Research Fund		16,584.00
TOTAL EXPENSE		$308,225.92
NET INCOME		$ 12,409.80

*By Council action, includes expenditures for Headquarters Renovation.
**By Council action, includes Golden Anniversary and Brochure.
***By Council action, includes Series XVIII, Home Lighting Data Sheets and Reprints.

Balance Sheet as of September 30, 1956

ASSETS

Cash in Banks		$ 80,012.54
Petty Cash Fund		$300.00
Accounts Receivable		18,021.57
Investments (Cost)	$ 82,685.01	
Accrued Increments, U. S. Savings Bonds	1,658.00	84,343.01
Inventories, Publications		12,403.54
Furniture and Fixtures		1.00
Deferred Charges to Expense of 1956-57		
Sections and Chapters	3,878.49	
ILLUMINATING ENGINEERING	8,340.73	
General Office Expense	2,430.34	14,649.56
Accrued Interest on Investments		112.50
TOTAL ASSETS		$209,843.72

LIABILITIES AND SURPLUS

Liabilities		
Accounts Payable		$ 18,548.32
Deferred Income		
Dues Received in Advance	$ 1,775.05	
Subscriptions Received in Advance*	8,818.31	
Trust Fund, Retirement Pension Plan	1,992.41	12,585.77
Surplus		178,709.63
TOTAL LIABILITIES AND SURPLUS		$209,843.72

*Includes subscription to Daylighting Committee Projects to be used in 1956-57.

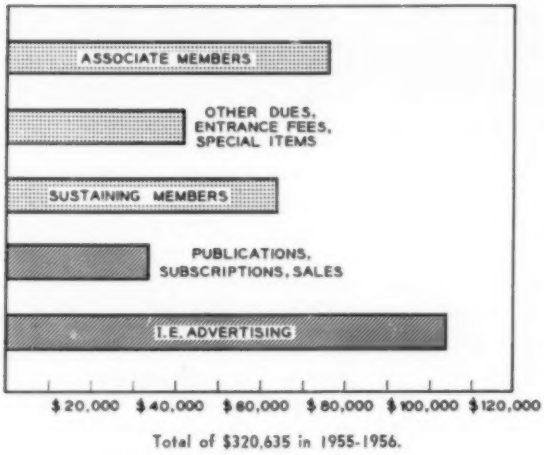


Figure 3. The Society's financial support.

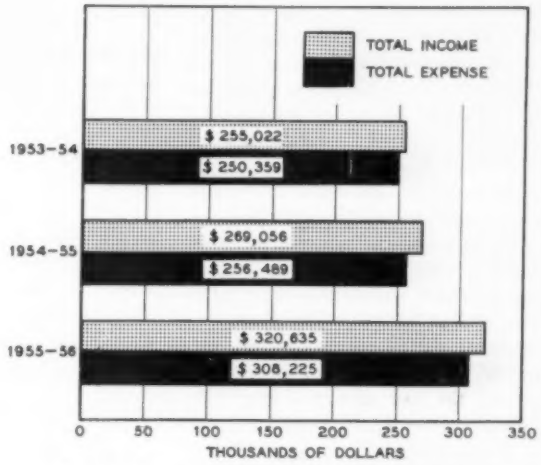


Figure 4. Comparison of income and expense.

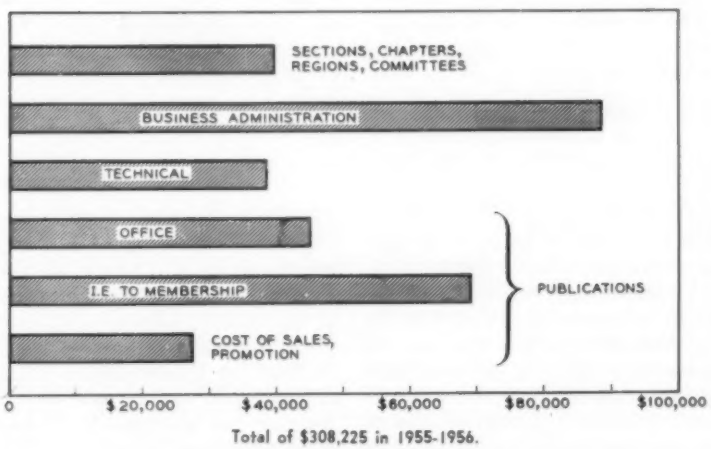


Figure 5. Cost of the Society's services.

figures from these statements have been converted to the usual chart form to show the Society's Financial Support (Fig. 3), the Cost of Society Services (Fig. 5), and the Comparison of Income and Expense for the last three years (Fig. 4).

Procedures and Policies

The Committee, with G. W. Beals, Chairman, conducted its affairs by one formal meeting, several conferences between members, and considerable correspondenc. A report was submitted to the President's Advisory Board clarifying the status and duties of this Committee relative to the Advance Planning and Constitution and By-Laws Committees. The report also included recommendations for improved procedure in Council for handling matters concerning policy and constitutional amendments.

As a development out of the recommendation of the Advance Planning Committee in June, 1955, the Committee presented to Council a proposed policy statement on the subject of "Committees." The Committee's report, accepted by Council at its April meeting, approved for inclusion in the Manual of Procedures and Policies the following statement:

IES Policy — Committees

"It shall be the policy of the Society to limit the number of committees appointed to those actually needed and active in the current year. It shall also be the policy to print in ILLUMINATING ENGINEERING the names of Members of the Major Committees and Subcommittees."

A policy recommendation regarding Publication of Transactions is in process of final review in the Committee and should be ready for submission to Council at an early meeting. The Committee has two assignments now under consideration dealing with Trophy Awards for National Winners of MMILJ Contest and Voting Privilege of Sustaining Members.

Constitution and By-Laws

The Committee with G. Franklin Dean, Chairman held one General Meeting, and several meetings between members of the Committee were held during the year. Considerable volume of correspondence also resulted from requests by Council to prepare and submit reports.

As a development of the report of the June 1955 Advance Planning Committee the Committee prepared and submitted a report covering amendments necessitated by a new grade of Senior Member. After discussion by Council of the relative qualifications for Member and Senior Member grades, the Committee was instructed to prepare a revised report with power to incorporate its decisions but also to follow Council's wish to maintain at a high level the qualifications for Member grade. A report was also given at December meeting on the amendments required by a change proposed by the Task Committee on Society Dues whose report had previously been accepted by Council at the October meeting.

For the January meeting of Council

Executive Committee, a progress report was submitted on (a) Member and Senior Member qualifications, (b) Dues and (c) a proposed new grade of Life Member, which was subsequently changed to Retired Member. With the incorporation of several changes proposed by Council Executive Committee, the final amendments covering the preceding actions were prepared for letter ballot to be sent to members of Council. The results of part of this letter ballot presented at February Council meeting indicated that Council had not approved the new grade of Senior Member or the new dues schedule. The Committee was subsequently instructed to prepare another amendment in Article IV — Dues, for a revised schedule having slightly lower amounts for Fellows, Members and Associate Members than the former proposed schedule. This amendment, including Retired Member grade, was submitted by letter ballot to the Council members, after receiving approval by the Council Executive Committee at its March meeting. At the April Council meeting, it was reported that this letter ballot had received unanimous approval by Council following which the corresponding ballot was sent to the entire membership.

At the June meeting of Council necessary changes in the By-Laws as a result of the preceding Constitutional amendments and the addition of two new Regions were submitted by the Committee for consideration by Council. With modification in one draft By-Law, action was taken to submit the revised By-Laws for letter ballot to Council members.

The committee is at present engaged in preparing a draft of a major revision to the Constitution as directed by Council, to separate basic policy and organization from procedure and detail and to eliminate inconsistencies.

The action of the general membership in the annual ballot was included in the report of the committee of tellers, presented to the June Council meeting. The approved amendments are as follows (new material in italics, deleted material in parentheses).

ARTICLE II — Membership

Section 1: The members of this Society shall be designated as Student Members, Associate Members, Members, Fellows, Members Emeritus, Honorary Members, *Retired members* and Sustaining Members.

ARTICLE II — Membership

Section 9: NEW — *A Retired member shall be or have been an individual member who has retired from regular occupation in business or profession, who has been in good standing for a period of thirty (30) years and who is not less than sixty-five (65) years of age. Retired members shall be entitled to all privileges of the Society except the right to hold elective office.*

ARTICLE III — Admission and Expulsion of Members

Section 3: An application for transfer to the grade of Member, *or Retired member,* shall be made in a form prescribed by the Council (and shall bear endorsement or references as prescribed in Section 2). *Applications for transfer to the grade of Member shall bear endorsements or references as prescribed in Section 2.*

ARTICLE III — Admission and Expulsion of Members

Section 4: All applications for admission to membership, or transfer to the grade of Member, *or Retired member,* shall be referred to the Board of Managers of any Section or Chapter within whose territory the applicant may reside, and thereafter passed upon by the General Board of Examiners. All applications for grade of Member (or recommendations for transfer to the grade of Fellow), *Retired member or recommendations for transfer to the grade of* Member Emeritus, shall become effective upon approval by the Council.

ARTICLE IV — Dues

Section 2: PREVIOUSLY — The annual dues for Associate Members shall be $13.50, for Members $15.00, and for Fellows $15.00. Annual dues for Student Members shall be $5.00. The annual dues for all grades of individual membership held by persons residing outside of the U.S.A., its possessions, and Canada shall be 50 per cent of the foregoing respective amounts. These dues shall include one subscription to the designated official publication of the Society.

Section 2: NEW — *The annual dues for members shall be according to the following schedule:*

Members and Fellows	*$18.00*
Associate Members	
During first three years	*$13.50*
After three full years in this grade dues shall be increased October 1st to	*$16.00*
After six full years in this grade dues shall be increased October 1st to	*$18.00*
Student Members and Retired members	*$ 5.00*

The annual dues for all grades of individual membership held by persons residing outside U.S.A., its possessions and Canada, shall be 50 per cent of the foregoing amounts.

ARTICLE VII — Management

Section 14: The General Board of Examiners shall evaluate the eligibility of applicants for admission to membership or for transfer to the grade of Member, *or Retired member* according to procedures approved by the Council. The Board shall submit to Council nominations for election or transfer to the grade of Member, *or Retired member* and nominations to the grade of Member Emeritus.

Management

Under the Constitution and By-Laws the Council of the Society is charged with managing the affairs of the Society. The Council consists of the officers of the Society, the two most recent Past-Presidents, six Directors and the ten Regional Vice-Presidents. During the past year the Council held the specified five meetings in alternate months beginning in October, and despite the sizable travel distances for some, made an over-all attendance record of 72 per cent. With few exceptions, members of Council unable to be present, were represented by proxies. In the months between Council meetings the management of the Society was carried on by Council's Executive Committee, made up of the Society's five national officers.

The affairs of the Society were carried out through the work of its officers and its committees, to whom various responsibilities were assigned. In all cases, however, the ultimate responsibility resided in the Council, and its decisions from month to month were recorded in some 251 pages of minutes.

Each meeting of Council (or the Executive Committee) received and acted upon reports of the General Board of Examiners, the Finance Committee, the Committee on Sustaining Membership, the Committee on Re-

gional Activities, and the General Secretary's report on the receipts, expenditures and liquid assets of the Society.

Regular reports were also received on the membership status, especially in respect to the delinquent members. The Council received regularly at each meeting a report on the Society's Technical Committee program presented by C. L. Crouch, Technical Director.

As the work of other standing, general and technical committees was completed, reports of these projects were received by Council, for approval, and in some cases for approval by letter ballot of Council.

As the first of its special tasks, the Council attended the Annual Meeting of the Society held, as is customary, in New York on the second Thursday in October. Here a review of the proceedings of the Society was given and Council acted to confirm and approve all the actions of the Society as taken during the previous year.

Two of Council's largest tasks were encountered at its first meeting in October. It received the President's recommendations as to the appointment of all committees to serve during the year, and acted upon these. The second task in October was in the consideration of a budget for the year, as developed by the Finance Committee and Council Executive Committee jointly during the previous summer months.

During the year the Council (and Executive Committee) discussed and acted upon several important revisions of the Constitution and By-Laws, leading to revisions approved by the general membership. The Council also cooperated fully in implementing the programs and actions proposed by the Headquarters Planning Committee and the Golden Anniversary Task Committee.

Official action was taken by Council in connection with the following reports of technical committees, during the year:

Institutional Lighting Committee — "Lighting for Commercial Kitchens."
Lighting Education Committee — "Demand for Professionally Trained Illuminating Engineers."
Civil Defense Committee — "Conillum Technical Manual."
Lighting Education Committee — "Experiments with Light."
Testing Procedures Committee — "IES Guide for Electrical Measurement of Mercury Vapor Lamps, 1955."
Testing Procedures Committee — "IES Guide for Life Performance Testing of Fluorescent Lamps."
Progress Committee — Lighting Progress in 1954-1955.

Representatives to Other Organizations

The Society continued to maintain relations with other associations and agencies in the fields of science, engineering and standardization through the appointment of official representatives. These included members serving on Sectional Committees of the American Standards Association with C. L. Crouch, Technical Director, serving in each case as alternate representative. Official Representatives were also appointed to the following:

American Association for the Advancement of Science, Governing Board
Armed Services N.R.C. Vision Committee
Industry Committee in Connection with the Revision of "Handbook of Interior Wiring Design"
Institute of Traffic Engineers, Joint Committee on Highway Lighting
National Committee on Uniform Traffic Laws and Ordinances
National Research Council
President's Highway Safety Conference
Society of Motion Picture and Television Engineers
U. S. National Committee of the International Commission on Illumination
U. S. National Committee of the International Electrotechnical Committee

Illuminating Engineering Research Institute

The Trustees of the I.E.S. Research Fund presented to Council at its December meeting a proposal that the name of this independent research agency be changed to Illuminating Engineering Research Institute and that there be added to the stated objective, the statement "and for consultation on the basic scientific knowledge." The related revisions in the Trust Agreement were discussed at Council meetings and subsequently given formal approval by Council's letter ballot.

In accordance with the provisions of the Trust Agreement Council approved a list of candidates considered qualified for election as Trustees or as members of the Research Executive Committee, to fill vacancies in the two groups resulting from expiration of terms of office. From these nominations the Trustees acted to complete the Board and the membership of the Research Executive Committee with the following serving for the year:

Board of Trustees
A. F. Wakefield, *Chairman*
Franklin M. Foote, *Treasurer*

Conrad Berens	Willard E. Henges
R. F. Hartenstein	Duncan M. Jones
R. L. Biesele	Dean Farnsworth
H. F. Davidson	Glenn A. Fry
	R. M. Zabel

Ralph P. Wagner
C. L. Crouch, *Secretary*

Research Executive Committee
E. M. Strong, *Chairman*

With the presentation of the annual report of the Trustees to Council, Professor Strong outlined the progress on current projects including:

#22 — Pavement Surface Reflectance, Prof. J. O. Kraehenbuehl, University of Illinois
#23-B — Muscle Action Potentials as a Measure of Visual Performance Cost, Dr. Leonard C. Mead, Tufts College
#37-B — Factors Influencing the Nighttime Visibility of Roadway Obstacles, Prof. D. M. Finch, University of California
#45 — Angular Light-Reflectance of Materials Used in Offices, Training Quarters and on Ships, Cdr. Dean Farnsworth, U. S. Naval Submarine Base
#46 — Colliculo Spinal Paths, Dr. Warren S. McCulloch, Massachusetts Institute of Technology
#47A & B — Methods of Improving Visibility in Fog on Toll Roads, Prof. Charles Marsh, Pennsylvania State University and Dr. H. R. Blackwell, University of Michigan
#48 — Effects of Quality of Illumination and Color of Background on Color Preferences, Dr. Harry Helson, University of Texas
#49 — Hot Spots in Luminaires, Dr. Glenn A. Fry, Ohio State University
#50 — Brightness Computation in Daylighting Design, Prof. R. L. Biesele, University of Oklahoma

In addition to the above verbal reports, formal reports on projects have been published in ILLUMINATING ENGINEERING as follows:

"Brightness and Illumination by Interreflections in Enclosures," by Dr. Robert S. Wiseman (Project #35)
"Relation of Changes in Pupil Size to Visual Discomfort," by Drs. Jack M. Fugate and Glenn A. Fry (Project #43)
"Color Rendition with Fluorescent Sources of Illumination," by Drs. Harry Helson, Deane B. Judd and Martha Wilson (Project #11-B)

Publications

Organization—With J. S. Schuchert continuing as Chairman, the national committee organization was again completely organized for the full year. Special efforts were directed toward improving the effectiveness of the Section and Chapter publications representatives as well as the Regional organization. The committee program had the full cooperation of Ruby Redford, Editor, and of Clayton E. Ellis, Advertising and Sales Promotion Manager.

The publications program was conducted on a sound financial basis with revenues appreciably exceeding the approved budget. During the year continuous consideration was given to changes and improvements in all of the publications in such matters as format, covers and general style.

Production — The Golden Anniversary Issue was an outstanding achievement. The aim of the staff and the

Page Content of ILLUMINATING ENGINEERING
October 1955 — September 1956

	Number of Pages Published
Conference Papers, Abstracts and Discussions	331
Technical Committee Reports	105
General Secretary's Report	14
Other Technical Papers	53
Application Articles	247
Data Sheets	53
Lighting News	129
Editorials	8
Committee Personnel, Officers, Sustaining Members	35
Advertising	452
TOTAL	1427

committee is to improve constantly the form and the content, the appeal and the value of our magazine, ILLUMINATING ENGINEERING. Hedley Davidson and Dr. R. M. Zabel and the Papers Committee serve as an Editorial Content Review Committee. Joseph Schneller attempts to obtain material for "I.E." from the field.

Data Sheets—J. A. Schneller, Chairman. Aileen Page, Chairman, Residential — The production and distribution of data sheets continue at the improved pace developed a few years ago. Extra effort on residential lighting data sheets adds to the tangible accomplishments of the Society in the home lighting field.

"IES Dividends" — R. W. Morris, Chairman — The important report, "IES Dividends" always provides an interesting, informative, inspirational, illustrated outline of the accomplishments and the objectives of the Society. It was used extensively in efforts involving membership and sustaining membership as well as in the public relations and information program of the Society.

Research Brochure — W. R. Morris, Chairman — The writing and preparation of a research brochure which will present the important IES Research Program is under way.

Reprints, Reports, Recommended Practices — The distribution of those available and new items is an important phase of the dissemination responsibility.

Sales and Distribution — Brooks Chassaing, Chairman — Sales quotas were developed and assigned to every Section and/or Chapter. Many of the local sales organizations not only have been doing a good job with the limited material which has been available, but they also are organized to do an outstanding sales distribution and dissemination job with any major publication (such as Recommended Practices, etc.) which might be produced by the Society in the future.

Advertising — Since circulation of ILLUMINATING ENGINEERING has an important effect on advertising, efforts were made to increase the distribution to architects by utilities, and to secure increased participation in the Society by consulting electrical engineers. On this basis advertisers are gaining a stronger and stronger appreciation and understanding of the value of ILLUMINATING ENGINEERING as an advertising medium.

Standing Committees

Seven Standing Committees are set up by Constitutional provision and reference has been made earlier in this report to the work of three of these — Council Executive, Finance and Publications. Reports for the remaining four, follow.

Board of Fellows

W. V. C. Foulks, Chairman

The Board met in April to consider nominations for transfer to Grade of Fellow. Prior to the meeting each member was provided with information regarding all candidates, so that the members of the Board had opportunity to study the candidate qualifications before the meeting.

Ten nominations for the Grade of Fellow were approved and recommended to Council for action at its June meeting, along with suggested citations briefly describing the contributions of the nominees.

Papers

H. F. Davidson, Chairman

The technical program at the 1956 National Technical Conference consisted of 32 papers. The papers were selected from over 50 outlines received. The papers were grouped into nine sessions and discussion was stimulated by a discussion organizer appointed for each session. Only five half-days were available for technical sessions which required that two sessions be operated parallel in all cases except one.

The Tuesday afternoon session was a special event of the Conference and included three papers by invited speakers. The speakers and their subjects were as follows:

"Light and Vision — How We See," by Dr. Brian O'Brien, Director of Research, American Optical Co.
"Tomorrow's Power for Tomorrow's Lighting," by William Webster, Executive Vice-President, New England Power System.
"Lighting Research in Europe," by Dr. R. G. Hopkinson, Building Research Station, Department of Scientific and Industrial Research, Great Britain.

General Board of Examiners

S. W. Bruun, Chairman

During the past year a greater number of applications for higher membership ranks were processed by this Board than in any previous year. A total of 269 were recommended to Council for favorable action. In addition, four Member Emeritus elections were recommended for members proposed for this honor by their respective Sections.

The experience of the Board consistently proves that great care must be taken in passing upon the qualifications of the individual applicant in order that the constitutional requirements may surely be fulfilled. The Chapters and Sections were encouraged to screen their applicants with greater care and thus avoid unnecessary delay or embarrassment. The Board has striven to be fair in its judgment, for it must uphold the Constitutional stipulations as to qualifications of those seeking higher membership grades.

Medal Award Committee

Ward Harrison, Chairman

In accordance with usual procedure, the Committee held a first and a second meeting in New York City on January 10 and May 8, respectively. The qualifications of all nominees for the medal were given most careful consideration. It was the unanimous recommendation of the Committee to the Council that, because of his outstanding contributions both to ophthalmology and illumination, Dr. George S. Crampton be designated as recipient of the 1956 Gold Medal.

General Committees

The 16 General Committees of the Society are charged with the operating functions not handled by the Standing Committees, and not pertaining to the preparation of reports on scientific and engineering subjects. The work of three of these has been given in the preliminary part of this report — Pro-

cedures and Policies, Constitution and By-Laws, and Regional Activities. Reports for the balance of the General Committees, follow.

Advance Planning Committee

F. C. Winkler, Chairman

During the year the committee held several meetings and through considerable correspondence was able to consider a rather large number of suggestions. Among the matters considered the Committee is prepared to submit a number of recommendations to the Council including:

(1) Establishment of a new Technical Committee to be known as the School and Office Lighting Committee. This committee to be operated and controlled by a chairman who would appoint two subcommittee chairmen — one to handle the School Lighting Committee and one to handle the Office Lighting Committee.

(2) Reports from Committees coming to Council in regard to Policy matters are to be accepted by Council in every case, after which they are to be referred to the Procedure and Policy Committee for further study and final report.

(3) Appointment of a secretary for all Council meetings to record every single word uttered. Executive Secretary diagnose and make sure referrals to proper committees are handled and correct final minutes are prepared.

(4) Honor the President when he has completed his term of office by making him a Life Member with right to hold office and vote, but with all dues paid up.

(5) Recommendation that Council appoint a Task Committee to study primarily the suggestions contained in the manuscript by Mr. J. H. McCulloch dated November 24, 1955 with the sole aim of providing a guide or standard which will set up a process that will materially improve the operation of technical and other committees.

Advisory Board to the President

M. N. Waterman, Chairman

Functioning for the first year under its new and broadened scope the Advisory Board met four times and prepared recommendations for the President and President-Elect. These covered a proposed list of committees and personnel and suggested items for consideration in preparing the 1956-57 budget. These items represented a review of costs and benefits of present and proposed services of the Society.

Allied Arts

Karl A. Staley, Chairman

During the year the Committee assisted two new groups conducting student lighting contests, at Arizona State College, Tempe, Arizona, sponsored by the Arizona Section; and Kent State University, Akron University, and the Akron Institute of Art, sponsored by the Cleveland Section. In addition, seven Sections, three jointly with other national organizations — the American Institute of Architects and the American Society of Industrial Designers — conducted similar student programs. These included the Cleveland Section, Golden Gate Section, New England Section, New York Section, Ohio Valley Section, and the Philadelphia Section. The Central Maine Power Company and the Bangor Hydro-Electric Company sponsored a program with the University of Maine, along similar lines.

Winnipeg Chapter, Capital Section, and Eastern New York Section are organizing student programs next year.

Board of Nomination

E. M. Strong, Chairman

In accordance with the Constitutional provisions and following the procedure adopted by Council, the Board was formed with the three immediate Past-Presidents of the Society and representatives of each of the 10 Regions. The Board reviewed extensive records of candidates as submitted by the respective Regional Nominating Committees, and from these prepared a nomination ticket containing names of those deemed best suited to serve as officers and directors in the positions to be filled at the ensuing election.

Defense Coordinating

A. F. Wakefield, J. W. Bateman, Co-Chairmen

The military organizations of Government can draw upon the inherent knowledge of its citizens only through awkward means except where such a Society as ours has a committee of this sort.

On lighting and visual problems the Committee can offer the counsel of the best minds in the world, since such men are usually over military age and somewhat frustrated in times of National stress to think that they normally are not asked to make a contribution to the war effort in the same way as younger men.

The fifteen projects instituted in the ten years since World War II indicate:

(1) The practical acceptance of the plan,

(2) A readiness to render a public service on the part of the Society.

An occasional reminder to the Services, in the form of a letter, is sent out now and then and must be a refreshing idea in this highly commercialized world about us. A corollary of this offer to the Services is the fact that some responses keep the Society in tune with the advance practices of the sciences of the Services themselves.

A current report on Projects follows:

#9 — IES Aviation Lighting Committee: The work of this committee relating to military problems of helicopter lighting, heliport lighting, seadrome lighting, runway lighting for jet aircraft, etc.

#12 — IES Searchlight Committee: This committee is continuing to serve government defense departments.

#13 — U. S. Naval New London Submarine Base Medical Research Laboratory cooperative project with I.E. Research Institute.

#14 — Illumination and Color Standards for Conservation of Vision: Cooperation in production of leaflet No. 160-6-X for U. S. Air Force.

#16 — Bureau of Public Roads cooperation with I.E. Research Institute on lighting of express highways.

Historical

S. G. Hibben, Chairman

Continuing the activities that related to the Golden Anniversary Celebration, and to the 50th year conference, this committee cooperated with the general publicity work of the associated groups and with the Boston Conference committee.

One particular achievement was a search for, and location of, the correspondence of the first President and his associates, when the Society was being planned. This historical data generally appeared in printed form in the Anniversary issue of I.E., under the title of "The Society's First Year."

A handsome bronze plaque was designed, cast, and mounted on the wall in the lobby of the Sheraton-Astor Hotel in New York, marking the site of the Society's organization meeting. A special luncheon meeting on January 11, 1956, simulated the original gathering of 50 years ago, and a large number of Past-Presidents and other officials participated.

A draft was prepared from a mass of collected material on the half-cen-

tury story of lighting devices, this in anticipation of a published book in the near future. The headquarters library was increased, and plans laid for its enlargement, as well as usage.

Biographies were drafted of the careers of the outstanding pioneers in the lighting fraternity, and one more voice recording made of a Past President.

Contacts were made with the National Museum in Washington, looking towards an eventual historical collection of illuminants. The story of the first planned lighting job and of the history of the lighting of the White House was assembled in bound book form and presented to the First Lady, Mrs. Eisenhower, at the time of the East Central Regional Conference in May.

Lighting Service

L. E. Tayler, Chairman

The My Most Interesting Lighting Job Contest continued to be the principal activity of the committee. The local contest committees completed early plans resulting in 49 of the Society's Sections and Chapters scheduling contests.

The Lighting Service Forum held in conjunction with the National Technical Conference consisted of the national contest of regional winners. All regions were represented. The winners receiving certificates and cash prizes at the annual banquet were:

First Prize — Bill F. Jones,
Southern California Section
Second Prize — Miss Dorothy McGregor,
British Columbia Section
Third Prize — E. H. Schaefer,
Milwaukee Section
Fourth Prize — Louis N. Goodman,
New Orleans Section

Membership

W. A. Stannard, Chairman

The Committee again directed its efforts toward the election of new members and holding present members. The national Committee, made up of a representative from each Region, offered closer relationship with the local membership committees. Regional committees were also formed.

The membership activity continued in the pattern of the past three years with Sections and Chapters divided into four groups of comparable size. Assistance was given the local committeees through ample supplies of application forms, a membership promotion folder and a guide for Membership Committees. Monthly reports showing the standing in the campaign were sent all local committees, local and national officers.

The total gain was 1,178 new members which was close to our goal of 1,250. The winners in the gain part of the campaign were as follows:

Group I — New England
Group II — Southwestern
Group III — Winnipeg
Group IV — Bluenose

The low-loss part of the campaign introduced last year was continued, with extra effort being exerted to reduce the number of delinquent members and resignations. The winners for the low-loss part of the campaign were as follows:

Group I — New England
Group II — Milwaukee
Group III — Northwestern Ohio
Group IV — Panhandle

National Technical Conference Committee

James C. Forbes, Chairman

The Committee reviewed the plans and budget for the Fiftieth Anniversary Conference in Boston and recommended them to Council for approval early in the year. Considerable attention has been given to long-range planning with particular emphasis on a rotation plan between Regions to minimize the possibility of Conferences being held in a particular part of North America in succeeding years. The Regional Activities Committee has been a major channel of communication in this work.

Conference Registration Records

1944	Chicago, Illinois	721
1945	No Convention	
1946	Quebec, Quebec	807
1947	New Orleans, Louisiana	605
1948	Boston, Massachusetts	906
1949	French Lick, Indiana	668
1950	Pasadena, California	556
1951	Washington, D. C.	765
1952	Chicago, Illinois	859
1953	New York, New York	1,007
1954	Atlantic City, New Jersey	851
1955	Cleveland, Ohio	754
1956	Boston, Massachusetts	961

Public Relations and Information

J. F. Whitehead, Jr., Chairman

The Committee's principal activity during the year was directed toward the publicizing of the Society's Golden Anniversary. This was carried out at Section and Chapter level by the arrangement (in cooperation with the Golden Anniversary Committee) of special meetings at each local group for celebrating the Golden Anniversary. Beginning in January the Committee initiated a national program of Golden Anniversary publicity carried out by professional publicity counsel. This program used every possible opportunity for publicity including a number of special occasions, the programs of the nine regional conferences and the program of the National Technical Conference.

Residence Lighting Forums

Ruth Morris, Chairman

Two committee meetings were held in New York, the principal business being to plan the program for the Boston Conference; to study revisions to the Forums Operation Guide; and to discuss ways of stimulating the formation of new Forums. Two new Forums were established. St. Louis, organized in January, has held four meetings. Twin City started in February has had three programs. Georgia, Chicago, Michigan, New York, Tennessee Valley and Utah Forums continue active with increasing membership. Program subject matter included Luminous Ceilings, Wall Lighting, Luminous Rooms, Color, Picture Lighting, Lighting Planted Areas in the House and other interesting and timely topics. Prominent in this year's Forum activities were: the "Home Lighting Workshop for Teachers" put on by the Utah Forum; the "Design, Color and Lighting Conference" (2 sessions) promoted by the Michigan group; and the fifth year of New York's "Lighting Design Competition" for girls in academic and vocational high schools in New York City.

In the following summary of information on the Forum groups, several of the meetings were held jointly with the Section or groups representing allied interest.

Name	Membership	No. Meetings Held	Attendance
Georgia	100	6	484
Chicago	48	3	78
Michigan	197	6	632
New York	148	7	398
St. Louis	46	4	232
Tennessee Valley	55	5	229
Twin City	54	3	163
Utah	33	6	221
TOTALS	681	40	2,437

Sustaining Membership

Fred E. Guth, Chairman

In the organization of the year's program Members of this national Committee were identified with six

Sustaining Members for Past Eight Years

	Members	Dues Income
1949	315	$40,335.00
1950	316	40,235.00
1951	316	40,793.00
1952	335	41,735.00
1953	334	40,735.00
1954	336	40,635.00
1955	334	43,391.00
1956	414	63,893.00

general groups in the lighting industry (electric utilities, lighting fixture manufacturers, lamp manufacturers, residential lighting manufacturers, distributors and miscellaneous).

The committee pursued a most energetic campaign using especially the medium of personal letters to company executives. This effort toward securing a more equitable range of dues among the companies of various sizes was particularly successful among the first three of the groups named.

The committee stressed the importance of steady adequate financial support to the Society's research program and had the cooperation of Council through the adoption of a statement at the October Council meeting that

> "It is the current attitude of Council in respect to funds received from new Sustaining members and increased funds from present Sustaining Members —
> (a) that the Sustaining member may specify how he would like to have such new or increased funds allocated between research and other national Society services, and
> (b) that lacking such specifications, approximately two thirds of such new or increased funds will be allocated to research and approximately one third to other national Society services."

The committee activity during the year was so successful, that in accordance with the statement above, the Society was able to increase its 1955-1956 support to the I.E. Research Institute from the budgeted $6000, to a total of $16,584 for the year.

The committee organization at the Section and Chapter level was particularly effective in a number of the Society's local groups. Reports on these activities and the national committee's program were given in a number of monthly articles appearing in ILLUMINATING ENGINEERING, as well as in the monthly reports sent by the chairman to all local and national officers during the year. Recognition was given at the National Technical Conference in Boston to the local committees of five Sections and Chapters which had equalled or exceeded the goals set for the year. Those receiving such recognition were:

Chicago Section — Louis Rosenstein, Chairman; Paul Kauffman, Vice Chairman.

Connecticut Section — Francis Clark, Chairman.

New York Section — Matthew Veeck, Chairman.

Pittsburgh Section — Lloyd H. Lingemann, Chairman.

Suwannee River Chapter — Joe Crevasse, Chairman.

Task Committees

Golden Anniversary Task Committee

R. G. Slauer, Chairman

The Committee got under way in October, having for initial consideration the recommendations submitted by the Task Committee in the previous administration. The Committee organized a number of special events as well as developing publicity on the Society. Recognizing the anniversary of the meeting at which the Society was organized Jan. 10, 1906, the committee held a special luncheon on January 11 at the same location, the Hotel Astor in New York City. This was attended by many Past-Presidents and by a large number of local and national officers.

Starting at this same time, and continuing through the following months practically every one of the Sections and Chapters staged an anniversary meeting in many instances including in their programs the address and projection slides prepared by the Committee for these occasions.

Each of the nine Regional Conferences included in its program a special observance of the Society's Golden Anniversary, President Hartenstein taking the lead in this.

As indicated elsewhere in this report, this committee initiated the procedures leading to the selection of an Honorary Member — and the related presentation was one of the features of the Honors Session at the Anniversary Conference in Boston. At this same session the 1956 Gold Medal was presented and recognition certificates were presented to five leaders in other professions, whose work has assisted in furthering the efforts of the illuminating engineering profession. Also in observance of the Golden Anniversary, a special session of the Conference followed immediately after the Honors Session, at which three outstanding leaders in science and industry presented invited technical papers.

A notable contribution to the Golden Anniversary was made in the publication in January 1956 of the Anniversary issue of ILLUMINATING ENGINEERING giving a record of the Society's history as well as serving as a reference and guide to the Society's future.

Headquarters Planning Task Committee

George J. Taylor, Chairman

As approved by Council in February 1955 the renewal of a lease in the present premises was negotiated by the General Secretary. Also in accordance with Council action plans were developed for the use of the additional space made available upon the removal of the sub-tenant. Council gave approval to the plans and a special appropriation to cover the special expenses in the office renovation.

The committee also kept in contact with the plans for the Engineering Societies Center.

Society Dues, Task Committee

D. M. Jones, Chairman

Acting on the June 1955 report of the Advance Planning Committee, the Council appointed a Task Committee which undertook its studies and deliberation shortly thereafter. The committee's report, incorporating a new schedule of individual dues, was accepted by Council at its October meeting and served as a basis for the subsequent revision of the Constitution.

Tellers

Fred J. Orman, Chairman

In accordance with Constitutional provisions the Committee met following the close of the election ballot and counted the vote both on the National and Section offices. In this the Committee had the customary assistance of headquarters personnel both in the preparation of the forms and reports, as well as in the opening of the ballots and the making of a preliminary count.

Joint IES-US Public Health Service, Task Committee

J. F. Parsons, Chairman

Following the June 1955 action of Council in connection with the report, "How to Make a Lighting Survey; a Vision Survey," the Task Committee continued its cooperation with the Publications Committee in exploring costs and means for publication of reprints.

Certain tables will be published separately to replace Footcandle Survey Form (IS-10). Part II — Vision was published in the April 1956 issue of "Industrial Medicine and Surgery."

A questionnaire to ascertain the probable demand for the complete text is now being circulated by the Society and the USPHS to determine the quantity for the first printing in pamphlet form.

Honorary Members, Task Committee

H. L. Logan, Chairman

As a result of a recommendation of the Golden Anniversary Committee, Council appointed a Task Committee composed of the three most recent chairmen of the Board of Fellows. This Committee was asked to assist Council with the screening of a draft list and the further exploration of possible candidates.

Following a preliminary report the Committee presented to Council at its June meeting the nomination of one candidate, Dr. Irving Langmuir. When Dr. Langmuir could not be present in person at the National Technical Conference in Boston, the certificate of Honorary Membership was accepted for him by Willard C. Brown. Subsequently, in October, the certificate was presented with appropriate ceremony to Dr. Langmuir in Schenectady, the delegation for the Society being Mr. Brown, Chairman Logan and President Harten-stein.

Past Presidents Pin, Task Committee

D. M. Jones, Chairman

Acting on the suggestion of President Hartenstein, Council appointed this Committee to prepare a special pin for the Past-Presidents in connection with the Golden Anniversary. Following Council's approval of a design and a special appropriation these pins were produced and given to all Past-Presidents, presentation being made to those who were present at the opening session of the National Technical Conference in Boston.

Technical Committees

The Constitution provides for the establishment of technical committees to report upon scientific and engineering subjects. The technical committee activity was overseen by Marshall N. Waterman, Senior Vice-President, who was active in counseling and in following progress. The work was carried out by C. L. Crouch, Technical Director, and his associates at headquarters. Reports of the several committees on the year's program follow:

Aviation Lighting

D. C. Miller, Chairman

The Committee again held two conference-type meetings, each of two days duration. The first a Joint Technical Conference on air safety, held with the Civil Aeronautics Commission in November at the Technical Development Center in Indianapolis. In the late Spring the committee held the second conference, on anti-collision lights, heliport lighting and landing deck lighting.

Civil Defense, Lighting For

J. W. Bateman, J. C. Forbes, Co-Chairmen

During the early part of the fiscal year the Committee completed its preparation of material for the "Conillum Technical Manual" and this was approved by the Council at its October meeting. In May the Society received notification that as a result of changes in defense procedure and other factors, the decision had been made that there would be no further implementation of the CONILLUM plan, which would be held in abeyance in the event of future need.

Color and Illumination

R. C. Allison, Chairman

Subcommittee meetings were continued through the year.

Daylighting

H. B. Vincent, Chairman

A meeting of the Committee was held at Cleveland at the time of the 1955 Technical Conference with sixteen members and C. L. Crouch, Technical Director, in attendance. Interim reports were received from several subcommittees to which specific tasks had been assigned. Mr. A. A. Brainerd reviewed briefly the meeting of the CIE Natural Daylight Committee in Zurich in June 1955 and presented six recommendations proposed by that committee. Subsequently, a letter ballot was circulated to all members of the Daylighting Committee requesting approval or comments. Results were transmitted to the U. S. National Committee for consideration.

Several subcommittees have been appointed or continued as follows:

Revision of Recommended Practice of Daylighting — Chairman, R. A. Miller; Vice-Chairman, R. W. McKinley. In the preparation of the revision, it has appeared desirable to provide editorial service. Arrangements for such services have been completed and funds to cover incidental costs are being solicited.

Measurement and Reporting on the Daylighting of Interiors — Chairman, J. W. Griffith. This subcommittee is preparing a final report on a comprehensive system for submission to the Committee. Activities looking toward devising a simplified system may be continued.

Availability of Daylight (Exterior) — Chairman, B. F. Greene. This subcommittee expects to complete a final report in the near future.

Lower Ceiling Classrooms — Chairman, H. F. Kingsbury. This subcommittee has completed a final report for committee consideration.

Brightness Ratio Measurements — Chairman, W. J. Arner. Studies are in process.

Co-ordinating Subcommittee—Chairman, R. A. Boyd. Cooperation in the preparation of material for the Handbook and for the School Lighting Committee is in process.

Design Practice

B. S. Benson, Jr., Chairman

The scope of this committee was to study published data on coefficients of utilization, room indexes, maintenance coefficients and other elements entering into calculations for lighting design; develop standard methods for use in Society publications and report thereon.

This year saw the publication in ILLUMINATING ENGINEERING (May 1956, p. 385) of the full text and appendix of the Zonal Factor Interflect-

ance Method of calculating coefficients of utilization.

The present subjects are now under study by the committee:

(1) An alternate simplified procedure for Step I of the Zonal Factor Interflectance Method.
(2) Indirect component coefficient of utilization data.
(3) Investigation of room ratio formulas.
(4) Floodlighting calculations.
(5) Maintenance factors (including definition).
(6) Standardization of calculations for large area luminous elements.
(7) Relationship of minimum, maximum and average illumination values.

In addition to the "basic" studies the committee has embarked on the revision of the "Calculations" section of the I.E.S. Lighting Handbook (Third Edition).

Education

H. H. Magdsick, Chairman

The comprehensive revision of "Experiments with Light" for use in secondary school science classes was approved by Council and submitted for publication. Wide distribution of this practical and authentic teaching material will bring about a more general understanding of principles of good lighting and of the varied and important role light plays in human activities; and thus will serve also as the Society's most effective means of interesting high school students in preparing for careers in this field.

Council approved the report on the survey of the demand over the next five years for professionally trained illuminating engineers. This report appeared in the July issue of ILLUMINATING ENGINEERING.

A subcommittee has in preparation a brochure on career opportunities in illuminating engineering, for distribution to engineering students.

At the 1956 Convention of the American Society for Engineering Education, on the initiative of Prof. E. M. Strong, with the help of other members of our subcommittee on Curriculum, faculty members interested in the teaching of courses in illuminating engineering undertook the organization of a group within the Electrical Engineering Division. Inasmuch as a greater number of such faculty members find it feasible to participate under ASEE auspices and find there is a better opportunity to enlist the interest of administrative officials of the engineering schools, the new group can more effectively perform the function heretofore assigned to our subcommittee.

Farm Lighting

O. C. Lange, Chairman

Two subcommittee meetings were held during the year, both devoted to working out details relative to the proposed lighting supplement for the Farmstead Wiring Handbook. This is in line with the Committee's 1955 decision to prepare a supplement that would recommend types of luminaires and equipment to be used for the various lighting applications listed in the *Handbook*. Since the purpose of the *Handbook* is to establish a list of wiring recommendations, it only suggests, in most part, the spacing of lighting outlets.

The two meetings were in the nature of subcommittee meetings, since the entire Farm Lighting Committee was not called upon to work on the supplement. One meeting was held in Cleveland in December 1955, while the other was held in Madison, Wisconsin last May. Upon completion, the first draft of the supplement will be reviewed by the entire Committee.

IES-ASHAE Joint Committee

Walter Sturrock, Chairman

Studies are being continued on the "Thermal Aspects of the Lighting System" in anticipation of a second report (Part II) analyzing the contribution which electric lighting and daylight make toward the required heating system for a building. A first draft of the studies was discussed at a July committee meeting.

Plans for publishing Part I of the committee report were completed. The ASHAE was supplied with originals from which to reproduce 100 copies of the complete manuscript which they made available to their interested members. In addition, the September 1956 issue of the ASHAE Journal scheduled the section of the report which the committee recommended for general distribution. Likewise, the September 1956 issue of ILLUMINATING ENGINEERING presented that part of the report as recommended for distribution to our members.

Illumination Performance Recommendations

B. S. Benson, Jr., Chairman

The scope of this Committee was to prepare illumination performance recommendations for luminaires conforming to CIE classifications, exeluding residential.

The work of this Committee is temporarily halted due to lack of factual information relative to luminaire brightnesses and their effect on vision. Studies leading toward such factual data are now being undertaken by others. When the result of these studies becomes available, work of this Committee can resume.

Industrial Lighting

W. P. Lowell, Jr., Chairman

The Committee held two meetings during the year. It has progress to report in the completion of subcommittee report "Lighting of Inspection Area — Redwood Lumber Industry," which was submitted to Council. The Committee at its second meeting set up the organization of an enlarged subcommittee to prepare a revision of the "Recommended Practice of Industrial Lighting" and to revise a section of the *I.E.S. Lighting Handbook*, E. A. Linsday, Chairman.

Several of the subcommittees have reported progress as follows:

Central Station Properties — L. G. Parks, Chairman, has completed the revision of its report, "Lighting of Outdoor Areas."

Work continues on "Lighting of Miscellaneous Areas."

Graphic Arts—Printing Industry — Ralph Enghouser, Chairman, has continued its study of visibility measurements of composing room seeing tasks, and of color reproduction.

Clothing Industry — Norman Kridel, Chairman, continues its studies of the visibility of markings and the sewing of various threads on suiting materials.

Sawmills — James Barnes, Chairman, is coordinating the two reports Part I—Laboratory Readings, and Part II—Field Studies, into a complete report for publication.

Mines — C. M. Crysler, Chairman, is continuing its study of types of equipment suitable for producing desirable levels of illumination for the tasks involved.

Outdoor Productive Area — E. H.

Witte, Chairman, has laid out a comprehensive study program with railroad yards as one of its first specific projects.

Institutional Lighting

James H. McCulloch, Chairman

The Subcommittee on Commercial Kitchen Lighting, Carl W. Zersen, Chairman, completed its report on Lighting for Commercial Kitchens, including details as to recommended illumination levels, color temperature of light sources, brightness controls and other related factors for these areas. The report was approved by Council and published in ILLUMINATING ENGINEERING in July 1956.

Lighting in Theatres — Joel E. Rubin, Chairman, continued its studies on several projects during the year. These include studies of uniformity of presentation of data for theater lighting equipment, the lighting of school stages and auditoriums and the lighting of theaters.

Auditoriums and Churches — George Shoemaker, Chairman, has developed an outline as a basis for a report.

Light Control and Equipment Design

Eric H. Church, Chairman

The work of the Committee consists of an assignment to revise one section of the *Handbook* (Third Edition). The Committee is composed of several subcommittees: Physics of Light Control, Practical Concepts of Equipment and Design, the Mathematics of Light Control, Materials Used in Light Control, and Plastics for Lighting. Three meetings were held during the year, leading to first draft of a report to be available next year.

Light Sources

E. H. Salter, Chairman

The Committee reports the following progress for the year:

(1) Data have been accumulated for the continuation of the question and answer page in ILLUMINATING ENGINEERING.

(2) Work continues on the report covering the effects of high and low ambient temperature, drafts, etc., on the starting, light output and color of fluorescent lamps.

(3) The subcommittee on the development of a method of measuring and specifying the color rendition properties of light sources continues its work under the chairmanship of Miss Dorothy Nickerson.

(4) The committee has served to gather information on a number of specific questions that have come to the Society Headquarters.

Lighting Maintenance

R. L. Zahour, Chairman

During the year, the Committee held two meetings.

Data accumulated from Dirtometers placed in the field for at least one year, were compiled and studied by Committee members to determine if the Dirtometer method was suitable for this purpose. At the second meeting, Committee members approved the Dirtometer as a method of determining the dust and dirt collections on luminaire surfaces over a period of time. This method includes determination of data on transmission as well as reflectance.

Work will continue by subcommittees to arrive at methods for determining dust and dirt collections on wall and ceiling surfaces. Data on aging of light sources are also being accumulated.

Motor Vehicle (Exterior) Lighting

Ray P. Teele, Chairman

The Committee prepared a set of "Tips to the Motorist" for use in the Safe-Driving Day campaign in 1955. This document was revised for use in the 1956 S-D day campaign. Suggestions for Display of Traffic Lights and a proposed system for rear lights for automobiles are now under consideration by the Committee. Under consideration is a suggested project, the preparation of a guide or standard practice for the motorist on night driving.

Nomenclature

Priscilla Presbrey, Chairman

For various reasons the Committee has held no meeting this year. The status of ASA Z7.1-1942, Illuminating Engineering Nomenclature and Photometric Standards, remains essentially as it was at the end of last year: Section 05, Photometric Quantities; Section 10, Radiation; and Section 30, Characteristics of Surfaces and Media for Controlling Light, are considered to be complete and to need no review at the present time. The other sections are under consideration for thorough revision, and it is planned to add at least one new section, on Light and Vision.

Office Lighting

John J. Neidhart, Chairman

The revision of the Recommended Practice for Office Lighting was published in the June 1956 issue of ILLUMINATING ENGINEERING.

Progress

James H. McCulloch, Chairman

The Committee maintained contact with the art of lighting throughout the world and prepared the yearly review of the achievements in the art of lighting for publication in ILLUMINATING ENGINEERING. This review was given a dramatic presentation as one of the features of the 1956 National Technical Conference in Boston.

Public Conveyances, Interior Lighting

Carl E. Egeler, Chairman

The Subcommittee on Lighting for Land Transportation, has underway revision of the Recommended Practice for this field. The revision will include improvements in both the quality and the quantity of the illumination for railway cars, buses, street and subway cars. New sources, techniques and equipments, as well as new light-weight trains, warrant extensive changes.

The Marine Lighting Subcommittee has nearly completed its Report on a Recommended Practice for submission to the Council.

Residence Lighting

Frank J. Marriett, Chairman

The work of the Committee continued on a number of major projects including the revision of the "Contemporary Lighting Practice in Modern and Traditional Interiors." The Subcommittee on "Portable Lamps—Measurement of Characteristics of Performance" continued its study of instruments to measure loss of contrast due to specular reflection and degree of shadow and diffusion. The Subcommittee on "Outline for Training Program" was enlarged and strengthened and will continue to develop outlines designed for use by study groups and other interested organizations wishing

to offer training programs on Residential Lighting.

School Lighting

J. M. Chorlton, Chairman

The principal activity of the Committee has been the review of proposed revisions in the American Standard Practice of School Lighting, 1948. The committee has received reports through the year on the deliberations of the joint Task Committee composed of the Society's representatives along with those of the School Committee of the American Institute of Architects and the National Council of Schoolhouse Construction, co-sponsors of the American Standard Practice of School Lighting.

At the close of the year, the Committee was about equally divided on two controversial points which developed around brightness limitations of luminaires in the direct glare zone and the downward brightness limitation to reduce loss of contrast through specular reflection. Efforts continued toward securing agreement among the Committee.

Searchlight

J. A. Bartelt, Chairman

The Committee held one meeting, which included a technical conference at the Materials Laboratory, New York Naval Shipyard. The agenda included reports by subcommittee chairmen, several technical papers, and a tour of the laboratory facilities. On another occasion, members of the Committee witnessed an interesting demonstration of the use of searchlights on helicopters for Air-Sea Reserve, by the Bureau of Aeronautics, Navy Dept.

Subcommittees continued their respective programs, as follows:

Nomenclature — Ernest Boghosian, Chairman. A supplemental list of definitions was prepared. This, together with the previous list, has been compiled into a report which includes a complete set of definitions applicable to searchlight technology.

Visibility of Targets — A. H. Clarke, Chairman. A study is being made of literature in this field. This study includes a determination of the practicability of developing a guide which would include basic tables and charts for solution of target visibility problems.

Visibility of Sources — W. A. Pennow, Chairman. National Bureau of Standards Report No. 4554 by Charles Douglas on "Computation of the Effective Intensity of Flashing Lights" has been reviewed by the subcommittee and is endorsed as a method of evaluating the effectiveness of searchlights when used for signalling purposes.

Light Sources — R. E. Faucett, Chairman. A draft of a form for listing pertinent characteristics of searchlight sources was prepared. Subcommitte members have submitted sample forms filled out to list characteristics of typical sources. The form is being reviewed for adequacy and completeness. When finally adopted, it will be circulated for general use.

Optics — D. Peterson, Chairman. This subcommittee is studying reflector-source combinations, door covers and reflector manufacturing processes.

Testing Procedures — T. H. Projector, Chairman. A draft of a proposed Guide for Photometric Testing of Searchlights was submitted by the Society's Testing Procedures Committee to the subcommittee for review. The Guide was studied extensively and a revised draft was completed. The final draft was returned to the Testing Procedures Committee for final review prior to publication.

Bibliography — J. P. Latil, Chairman. The bibliography subcommittee has continued to compile references of interest in this field. Two supplemental lists of references were supplied to committee members during the past year. Additional copies of these and previous lists are available upon request.

Signal Lighting, Elements of

F. C. Breckenridge, Chairman

During the past year the Committee has devoted its attention to Part 4 of the Elements which treats of the visual range of signal lights in preparation for publication during the coming year.

Sports and Recreational Area Lighting

Francis D. Wyatt, Chairman

The Committee was organized in February and held its first meeting in April at which time 18 proposed sports lighting charts were reviewed for approval or revision. At the next meeting in June, nine of these lighting layouts were approved by the Committee. Six proposed lighting layouts were returned to their sponsors for corrections or revisions.

The Committee is working to complete 15 to 17 of the sports lighting layouts and submit these to Council before the end of the current year.

The "Current Recommended Practice for Sports Lighting" issued in August 1952 was recommended to the Athletic Institute of Chicago in the preparation of lighting information for their Handbook. It was also suggested for a text book on sports now being prepared.

The membership of the committee have started work on the next revision of the "Recommended Practice" and also on the proposed revision of a section of the *IES Lighting Handbook*.

Standards of Quality and Quantity for Interior Illumination

Glenn A. Fry, Chairman

The Committee has continued with the drafting of a new report (#6) which is concerned with direct discomfort glare. The work represents a continuation of the project started under Dr. Guth's chairmanship of this Committee. The work of the Committee has been carried on largely by correspondence and the proposed report has gone through two separate drafts.

During the year the Committee has been requested to undertake the formulation of a set of standards that apply to reflected glare. It is planned to carry this project through the preliminary discussion stage during the present year.

Store Lighting

C. M. Cutler, Chairman

Work continued during the year on the Store Lighting Guide which is composed of two sections. The draft of Section I and the first part of Section II is in the final stage. Three sub-sections of Part II are in various stages of draft form. Steps are being taken to select illustrations and specific design data for inclusion in the Guide.

During the year, the Subcommittee on Parking Areas and Service Stations, E. H. Schaefer, Chairman, held two group meetings (Eastern and Western) and considered the draft recommended practice on the lighting of parking areas, prepared by the Committee on Street and Highway Lighting. These meetings resulted in the production of a composite draft representing the thinking of the two groups.

Street and Highway Lighting

George K. Glass, Chairman

Following past practice the work of this Committee is accomplished by subcommittees with final reports and recommendations requiring nearly unanimous approval of the full committee. This report concerns itself with those subcommittees currently most active.

Tunnel and Underpass Lighting — Chairman, R. M. Swetland, has completed a report which is suggested as an interim report subject to subsequent modifications as further research and experience may warrant.

Visibility Under Fog Conditions — Chairman, E. E. Paul, has been active in setting up studies on this problem and investigation is now under way as I. E. Research Institute Project #47. Under this project measurement equipment has been developed at the University of Michigan and field studies will be made by the Pennsylvania State University.

Parking Area Lighting — Chairman, W. H. Edman, has prepared a report which has been submitted to the Store Lighting Committee for consideration of their subcommittee on the Lighting of Service Station and Parking Areas.

Pavement Surfaces — Chairman, F. D. Wyatt, is proceeding, with the aid of a group of volunteers, to chart the test data on reflectance of paving samples as taken at the University of Illinois and expects to present it in a practical usable form. These data were obtained under I.E.S. Research Fund Project #22.

Luminaire Maintenance — Chairman, H. E. Wall, has completed an interim report and has been requested to continue with the collection of information and test data.

Research—Chairman, D. A. Toenjes, reports progress on I.E.S. Research Institute Project #37 at the University of California. It deals with Night Visibility of Roadway Obstacles and measurements are now being taken. Interim reports have been given to the Committee. This subcommittee has also arranged for a paper at the National Technical Conference based on Laboratory Studies of Discomfort Glare at Street Lighting Brightness Levels conducted at Case Institute of Technology.

Standard Practice — Chairman, C. A. B. Halvorson, is beginning to collect comments and information towards the next proposed revision of the American Standard Practice for Street and Highway Lighting.

Roadway Lighting Principles — Chairman, C. H. Rex, is undertaking a comprehensive investigation of methods of evaluating street lighting systems.

Lighting for High Speed Heavy Traffic Density Highways — Chairman, P. B. Clark has been newly appointed. It is undertaking to accumulate and analyze all known literature and research on this problem, suggest additional studies, work with the vehicular lighting specialists, prepare such interim reports as are advisable, and initiate a Recommended Practice.

Television — Lighting for Production

Walter H. O'Mearn, Chairman

The Committee continued its 1955 project "Lighting Equipment Performance Rating" toward the establishment of a uniform standard for rating equipment performance.

Three subcommittees are working on this project — a subcommittee of this Committee, a subcommittee of the S.M.P.T.E. Television Lighting Committee, and a subcommittee of the Society's Theatre Lighting Subcommittee. There have been a number of joint Subcommittee meetings in the past year.

Testing Procedures for Illumination Characteristics

A. E. Kraweek, Chairman

The following progress has been made by the Committee on its principal assignments:

(1) "Guide for Life Performance Testing of Fluorescent Lamps" (Revision) — Miss Priscilla Presbrey, Chairman. Approved by Council at its February meeting.

(2) "Guide for Photometric Testing of Fluorescent Luminaires" (Revision of 1948 issue) — G. A. Horton, Chairman. Revision of this Guide is now in process.

(3) "Guide for Photometric Testing of Fluorescent Lamps" (Revision of 1948 issue) — A. W. Weeks, Chairman. This Guide has been completed and is now in process of approval by letter ballot.

(4) "Guide for Use of Portable Photometers" (Revision of 1937 Report)—G. A. Horton, Chairman. Work in progress.

(5) "Guide for the Photometric Testing of Outdoor Fluorescent Luminaires" — J. S. Franklin, Chairman. This Guide has been completed and is now in process of letter ballot.

(6) "Guide for Photometry of Searchlights" — A. E. Kraweek, Chairman. This completed Guide has been submitted to the Testing Procedures subcommittee of the Searchlight Committee for review and comment.

(7) "Guide for Electrical Measurements of Mercury Vapor Lamps" — J. S. Franklin, Chairman. This Guide was approved by Council at its February meeting.

(8) "Guide for the Photometric Measurements of Mercury Vapor Lamps" — J. S. Franklin, Chairman. The second draft of this Guide has been submitted to the entire committee for review and comments.

(9) "Practical Guide to Photometry" — Phelps Meaker, Chairman. Work is in progress on this Guide.

(10) "Guide for Reporting General Lighting Equipment Engineering Data" Elden Witte, Chairman. The third draft of this Guide was reviewed by the entire Committee.

(11) "Practical Guide for Brightness Measurement" — Paul H. Lamson, Chairman. A revised draft was submitted to the entire Committee at the June meeting.

(12) "Guide for Colorimetry"—Ray P. Teele, Chairman. The work on this Guide is just getting under way.

INSTALLATION AT PAGEL'S MEN'S STORE, 36 EAST MAIN ST., NORRISTOWN, PA.

Lighting a Men's Clothing Store

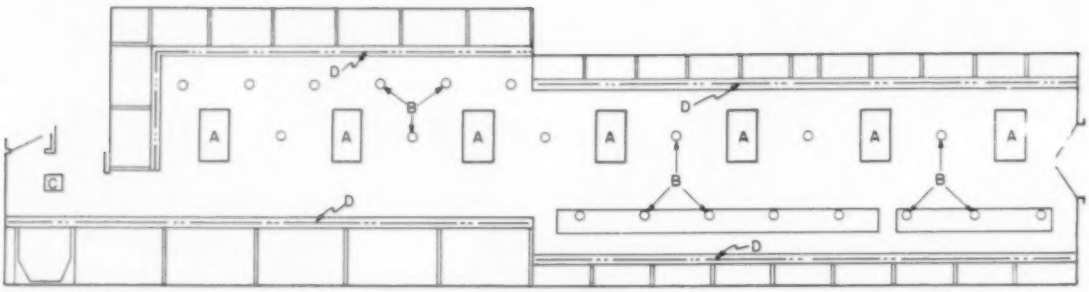
LIGHTING OBJECTIVE: To provide general illumination, downlighting for appraisal, and a pleasant atmosphere for shopping in a men's apparel store.

GENERAL INFORMATION: A complete line of men's accessories and apparel is merchandised in the area shown in Fig. 2. The ceiling height is 9 feet 6 inches. Colors and reflectances within this area are as follows:

	Color	Reflectance
Ceiling	White	80%
Walls	Beige	60%
Valances	Beige	23%
Cases		
Tops	Grey mahogany	37%
Sides	Grey mahogany	37%
Floor	Mottled brown	26%

(over)

A.I.A. File No. 31



A — Lighting Products Inc. catalog No. THR440 equipped with four 40-watt T-12 standard cool white fluorescent lamps.
B — General Lighting Co. catalog No. 258 equipped with one 150-watt R-40 flood or spot lamp.
C — Gotham Lighting Corp. catalog No. E1274 equipped with one 300-watt IF PS-30 lamp.
D — Metalcraft Products Co. catalog No. 4401 48-inch fluorescent channels equipped with one 40-watt T-12 standard cool white lamp.

Figure 2. Plan view showing location of lighting equipment.

INSTALLATION: Fig. 2, a plan view of the area, shows the luminaire locations and manufacturers data. The average level of illumination is 66 footcandles.

Brightnesses are as follows:

Ceiling		Cases	
darker area	11.6 ft-L	Tops	25 ft-L
above valances	55 ft-L	Sides	9 ft-L
Walls		Floor	14 ft-L
above valances	41 ft-L	Luminaires (A)	
Valances	8 ft-L	crosswise at 45°	760 ft-L
		longitudinal at 45°	760 ft-L

Lighting designed by Solomon Kaplan, Registered Architect, 2120 Spruce St., Philadelphia, Pa. Store designed by Solomon Kaplan. Electrical Contractor, Morris Newmark & Bro., Inc., 1924 Arch Street, Philadelphia, Pa.

Lighting data submitted by George C. Linthicum and George T. Anderson, Jr., Lighting Engineers of Philadelphia Electric Co., 211 S. Broad St., Philadelphia, Pa., as an illustration of good lighting practice and to aid in the design of similar installations.

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LIGHTING NEWS

A. Homer Manwaring Dies—Past-President of I.E.S.

A. Homer Manwaring

A. Homer Manwaring, President of I.E.S. in 1953-1954 died Sunday, November 11 following an illness of several months. He was 44 years old.

Mr. Manwaring's last public appearance before an I.E.S. group was during the National Technical Conference in Boston last September, where he participated in the Convocation Session honoring Presidents of the Society (see November IE, p. 9A). During his term of office two years ago, Mr. Manwaring attended every Regional Conference of I.E.S., and spoke before the Boards of numerous Sections and Chapters. Together with his wife, Esther, he made countless friends throughout the country.

Youngest man to achieve the presidency of I.E.S., Mr. Manwaring also had held the distinction of being one of the youngest executives in his industry. In 1942, at he age of 30, he was named Executive Vice-President and General Manager of the Philadelphia Electrical and Manufacturing Company (Pemco), and a member of his company's Board of Directors.

Active also in NEMA, Mr. Manwaring is widely known for his work with their Street Lighting Section, and for his service also on the Street and Highway Lighting Industry Advisory Committee of NPA.

Born in Philadelphia in 1912, Mr. Manwaring was graduated from Penn State College in 1934 with a B.S. degree in Industrial Engineering. From 1934 to 1936 he served as a lieutenant in the United States Marine Corps, and was a Cadet Engineer with the Philadelphia Electric Company. During 1942-1944 he served as Secretary for the Philadelphia War Production Pool.

Mr. Manwaring's services to I.E.S. were, of course, numerous and greatly valued. During the past 15 years he was member and/or chairman of many I.E.S. committees, and was elected to a number of offices both local and national. He was, continuously, a member of the I.E.S. Council from 1948 through this year, as General Secretary (1948-1951), two terms as a National Vice-President, and as President of I.E.S. during 1953-1954. At the time of his death he was Chairman of the Nominating Committee, and a member of the Committee on Medal Award.

Research Symposium Held on Light and Vision
Illuminating Engineering Research Institute Is Sponsor

A symposium which brought together for the first time reports on all of the various researches now under way on light, seeing, vision and color, was held September 13, 14 and 15, 1956, at Cornell University, Ithaca, N. Y. Sponsor for this unusual meeting was the Illuminating Engineering Research Institute. All of the arrangements for the meeting, including housing for those attending, were under the direction of C. L. Crouch, Secretary of the Research Institute, and Prof. E. M. Strong of Cornell University.

Symposium sessions were held in Phillips Hall, beautiful new engineering building at Cornell, affording excellent facilities for the research lectures. Some 120 people attended the three-day meeting, many of them on their way to the I.E.S. National Technical Conference held in Boston the following week.

Fifteen distinguished research scientists were presented during the symposium, each discussing the latest developments in the relationship of lighting to seeing and living, and outlining the findings to date from their researches. Six main subjects were discussed, each presenting basic concepts governing lighting practice and an up-to-the-minute review of current researches in those fields. Researches covered included: 1. How We See. 2. Quantity of illumination necessary. 3. Quality through evaluation and elimination of glare. 4. Color for living. 5. Researches abroad. 6. Instruments for field evaluation.

Full text of all of these reports, from tape recordings, will be available some time within the next month or two. Requests for this material may be directed to Prof. E. M. Strong, Cornell University, Ithaca, N. Y. Meanwhile, an eight-page multilith summary of all of the lectures may be obtained from C. L. Crouch, at I.E.S. headquarters.

The symposium's program also included a number of social features enjoyed by

Plastics Engineers To Hold Three-Day Conference

"Fifteen Years of Plastics Progress" is the theme for the 13th Annual Technical Conference of the Society of Plastics Engineers, Inc., to be held in St. Louis January 16-18, with headquarters at the Hotel Sheraton-Jefferson.

Registration fees for the conference are: members of SPE, $10; non-members of SPE, $15; ladies, $5. Further information may be obtained from the Society of Plastics Engineers, National Executive Offices, Suite 116-18, 34 East Putnam Ave., Greenwich, Conn.

both the delegates and the some 30 ladies accompanying them. Each day, morning and afternoon, Cornell University was host to a social coffee-break. On Friday evening, September 14, a dinner party was held at the Ithaca Hotel. A featured speaker at this pleasant affair was Ralph M. Evans of Eastman Kodak Company, who discussed, with beautiful slides, color photography.

The Symposium itself was opened by A. F. Wakefield, Chairman of the Institute's Board of Trustees, who outlined the aim of the Research Institute — to investigate and direct basic research in lighting. He noted the many questions still unanswered in illuminating engineering and in how we see.

Dr. Franklin M. Foote, Executive Director of the National Society for the Prevention of Blindness also addressed the meeting briefly as Treasurer of the Research Institute. Dr. Foote reported some 28 projects which have been completed by the Institute, and discussed a number of other essential researches being considered for early study.

Another pre-symposium speaker was C. L. Crouch, Secretary of the Institute and Technical Director of I.E.S. Mr. Crouch told the group how the Institute operates as an autonomous body directed by a Board of Trustees which has sole authority over the disposition of its funds. He noted that 14 additional researches are now under way in a number of universities. These cover a wide range of subjects, all aimed at obtaining answers to urgent problems in lighting which have been disclosed by everyday lighting practice and through the studies of the I.E.S. technical committees. Mr. Crouch showed slides demonstrating the structure of the Illuminating Research Institute and outlined the influence of both the Research Institute and of I.E.S. on other organizations, professional and commercial, and through their application to everyday use and to the public.

Formal program included:

How We See

Chairman — E. M. Strong, Cornell University.
Presentation of Research Institute Trustees — A. F. Wakefield, The Wakefield Co.
Organization and Activity of the Institute — C. L. Crouch, Technical Director, I.E.S.
Visual Reception — Warren S. McCulloch, Electronic Research Laboratory, Massachusetts Institute of Technology.
Brain Mechanisms in Seeing — Warren S. McCulloch.

Quantity of Illumination

Chairman—Glenn A. Fry, School of Optometry, Ohio State University.
Visual Discrimination — H. R. Blackwell, University of Michigan.
Effort and Quantity — Leonard C. Mead, Institute of Applied Experimental Phychology, Tufts College.
Seminar.

Quality of Illumination

Chairman — J. J. Neidhart, The Miller Co.
Disability Glare — Glenn A. Fry, School of Optometry, Ohio State University.

(Continued on page 10A)

Lecturers — Symposium on Light and Vision
Cornell University

HOW WE SEE — Speakers are, l. to r.: E. M. Strong, Session Chairman; C. L. Crouch; Warren S. McCulloch; A. F. Wakefield; Franklin M. Foote; R. G. Hopkinson.

QUANTITY Session — Leonard C. Mead, H. R. Blackwell and Glenn A. Fry.

QUALITY Session — Left to right: J. J. Neidhart, Session Chairman; S. K. Guth; Glenn A. Fry; John Chorlton; and J. M. Fugate.

COLOR Session — Harry Helson; Dorothy Nickerson; Warren B. Reese; Ralph Evans; Deane B. Judd, Session Chairman; and R. D. Burnham.

FIRST meetings of the year feature the handing over of the Section/Chapter gavel to the incoming Chairman. In the photo at left, Southeastern Regional Vice-President J. D. Mitchell presides as outgoing Chairman of the Suwannee River Chapter presents the gavel to incoming Chairman A. H. Bruning. In the Eastern New York Section ceremony, photo at right, incoming Chairman Cobe Hollister (left) receives the gavel from Art Peabody.

Beginning the New Year In October

1956-1957 Chairman of the Cornhusker Chapter Ford Bates receives the gavel from outgoing Chairman, C. P. "Pete" Haas, at the first Lighting Conference of the season in Omaha, October 12. Midwestern Regional Vice-President Joseph Schneller and Chicago Section Chairman Eric Church participated, along with Thomas Sidlo of Kansas City and past-Chairman Robert Gibb. Program Chairman for the Conference was John Peterson.

PRESENTATIONS of Fellow and Member Emeritus certificates also featured on "first meeting" programs. In photo at left, Milwaukee Section Chairman William Lisch presents the Fellow certificate to C. N. Laupp. In photo at right, at Michigan Section meeting Earl A. Anderson (left), newly-elected Fellow, and W. Clifton Randall, Member Emeritus, hold their certificates after presentation by A. C. Sangster, I.E.S. Director.

(Continued from page 8A)

Discomfort Glare: Subjective — S. K. Guth, General Electric Co.
Discomfort Glare: Physiological — Jack M. Fugate, School of Optometry, Ohio State University.
Quality in Schools — John Chorlton, Toronto Board of Education.

Color

Chairman — Deane B. Judd, National Bureau of Standards.
Seeing Color — R. W. Burnham, Color Technology Division, Eastman Kodak Co.
Color Discrimination — Warren Reese, Vice-President, The Macbeth Corp.
Color Designation and Rendition — Dorothy Nickerson, Color Technologist, U. S. Department of Agriculture.
Color Appearance and Color Preferences — Harry Helson, University of Texas.
Dinner: Address on Color — Ralph M. Evans, Color Technology Division, Eastman Kodak Co.

Research Abroad

Chairman — R. C. Putnam, Case Institute of Technology.
Researches in England and Abroad — R. G. Hopkinson, Director of the Building Research Station, Garston, Hertsfordshire, England.
Seminar.

Instrumentation

Chairman — J. W. Griffith, Southern Methodist University.
Contrast Threshold Meter in Street Lighting — D. M. Finch, University of California.
Disability Glare Meter — Glenn A. Fry, Ohio State University.
Contrast Threshold Meter for Interior Lighting — C. L. Cottrell, Cornell University.
Luckiesh-Moss Visibility Meter for Interior Lighting — Glenn A. Fry.

STORE Lighting Conference was a two-session clinic held by the Michigan Section. Shown here are speakers, Lloyd Crotser, Hugh Dutter and Robert Dorsey, with Program Chairman James F. Finn.

Michigan Store Lighting Conference Scores Huge Success

A two-session conference on store lighting, sponsored by the Michigan Section, attracted crowds of the right people to hear a panel of experts on the subject. The afternoon session, devoted to problems of design, was attended by 217 architects, engineers, contractors, displaymen, store designers and store owners; and the evening session, on applications, drew over 400. Held October 9 at the Detroit Edison Co., the conference attracted registrants from Toledo, Grand Rapids, Lansing, Flint, Saginaw and Pontiac in addition to Detroit.

Speakers on the panel were Lloyd W. Crotser, Westinghouse Lighting Sales Engineer, who spoke on Exterior Lighting; Hugh Dutter, Pittsburgh Reflector Co. Sales Engineer, on Window Lighting; and Robert Dorsey, General Electric Store Lighting Specialist, who covered Interior and Accent Lighting.

Pre-conference planning, which did much to insure the success of the program, included the mailing of 40,000 invitations to all segments of the electrical industry and 39,000 store owners in southeastern Michigan.

Program chairman was James F. Finn, Commercial Sales Division, Detroit Edison Co.

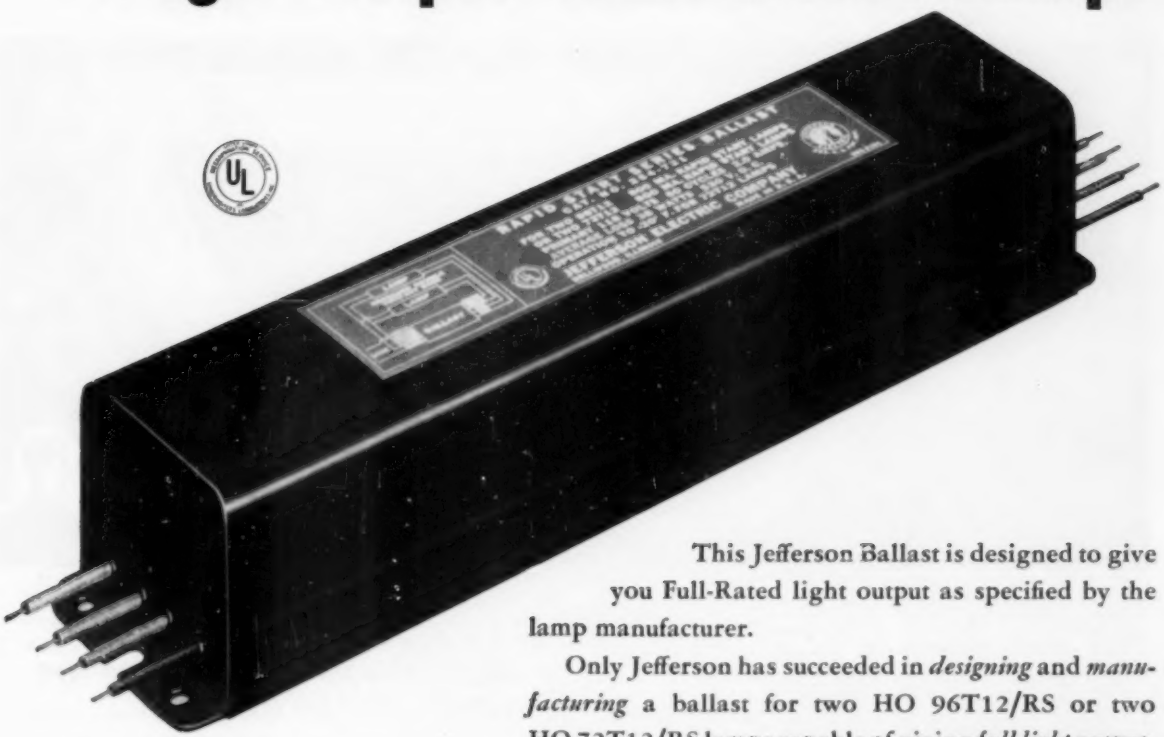
SCROLL of Honorary Membership in I.E.S. is presented to Dr. Irving Langmuir by President R. F. Hartenstein. Left to right are: Henry L. Logan, Mr. Hartenstein, Willard Brown, and Dr. Langmuir.

Honorary Member's Scroll Presented to Dr. Langmuir

In ceremonies conducted at the General Electric Research Laboratory in Schenectady, Dr. Irving Langmuir, Nobel Prize winning scientist, was made an honorary member of the Illuminating Engineering Society. Presentation of a special scroll was made to Dr. Langmuir by R. F. Hartenstein, immediate past-president of I.E.S. Also present for the occasion were: Henry L. Logan, chairman of the special I.E.S. Committee on Honorary Membership; Willard Brown, I.E.S. past-president; and to honor their colleague, Drs.

(Continued on page 13A)

Jefferson Ballast for 800 MA High Output Fluorescent Lamps



This Jefferson Ballast is designed to give you Full-Rated light output as specified by the lamp manufacturer.

Only Jefferson has succeeded in *designing* and *manufacturing* a ballast for two HO 96T12/RS or two HO 72T12/RS lamps capable of giving *full light* output.

Applications include medium and high bay industrial and commercial locations where high output is required.

It is recommended that surface mounted fixtures be checked for conformance to UL temperature requirements.

Remember—for full light output from the new High Output lamps, insist on Jefferson Ballast No. 254-721!

COMPLETE BALLAST SELECTION DATA

New Technical Bulletin B560-10 gives complete selection data on the entire Jefferson Ballast line in compact, easy-to-use form. Write for your copy today!

PRIMARY 118 VOLTS*—60 CYCLES—HIGH POWER FACTOR

Catalog No.	Watts	Lamps	MA	Approx. Watt Loss	Sound Group	Minimum Operating Temperature	Net Weight
254-721	(2)100/105	(2)96T12/RS	800	38	F	+50°F	13 Lbs.
	(2)85	(2)72T12/RS	800			−20°F	

Length 14 5/16", Width 3⅛", Height 2⅜", Mtg. Centers 13¾".

*For 277 Volt lines, specify Catalog No. 254-728.

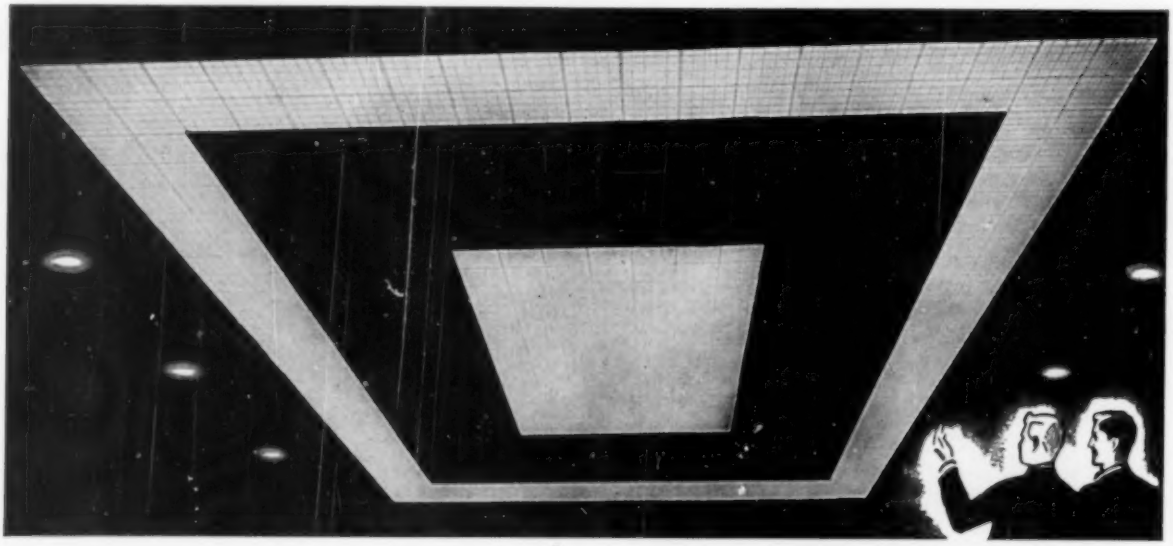
Jefferson Electric Company

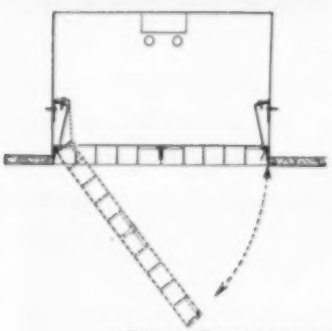
BELLWOOD, ILLINOIS

There is a place for

Dramatic LUVE-TILE

in every new building...or re-lighting job





- "**Luve-Tile**" can be hinged down from either side or completely removed for cleaning.
- Hinging arrangement also holds the "**Luve-Tile**" firmly in position. No bars or channels are necessary.
- Below—Recent installation of "**Luve-Tile**" demonstrates flexibility and dramatic appearance.

One-foot Square Louvred Panels Offer Practical, Creative Advances Over All Other Types —Particularly for Small Areas

Versatile — handsome — highly flexible, Luve-Tile is the delight of architects, illuminating engineers, contractors.

Designed by Wilson Engineers — manufactured under Wilson patents — it is (1) Easy to assemble to suit any area: no custom-made work necessary. No horizontal bars or rosettes required. (2) Easy to maintain — rigid, light in weight — easy to remove and wash. Dirt collection is retarded — does not hold insects, foreign matter. (3) Easy on the budget — Sprinklers and air ducts are concealed and wiring and other work may be simply surface mounted. Also low-cost acoustic material may be sprayed on the cavity above the tile for sound proofing. LUVE-TILE is practical and economical to use in any area, right down to a few square feet. It is also widely used in display for special effects.

Write for Luve-Tile Catalogue section No. 8.

"Engineered WILSON Seeing"

J. A. WILSON LIGHTING & DISPLAY INC.

260 DELAWARE AVE., BUFFALO 2, N.Y., PHONE MOhawk 5596

IN CANADA 280 LAKESHORE ROAD, TORONTO, ONTARIO

STOCKED AND DISTRIBUTED BY LEADING DISTRIBUTORS IN THE UNITED STATES & CANADA

(*Continued from page* 10A)

William D. Coolidge and A. W. Hull, former director and associate director, respectively, of the G-E Research Laboratory.

Other Honorary Members of the Society were Thomas Edison, Edward Nichols, Andre Blondell and Elihu Thompson.

Commercial Lighting Design — Six-Week Course in Buffalo

A six-week course, of two-hour sessions, in practical lighting application was offered by the Western New York Section of I.E.S., October 8 through November 15. The course, which was under the direction of J. F. Parsons, Chairman of the Section's Special Activities Committee, was for the purpose of providing grounding in the fundamentals of good current commercial lighting practice. Registration was 43 for the classes, which were held in the Electric Building Auditorium in Buffalo.

Expansion Planned for Certified Lighting Program

Representatives of four national electrical associations met with the Executive Committee of the National Lighting Bureau, National Electrical Manufacturers Association, November 9, to discuss methods of expanding the operation of the bureau's Certified Lighting Program. Representatives were present from the International Association of Electrical Leagues, Edison Electric Institute, National Association of Electrical Distributors and the National Electrical Contractors Association.

In a report of the progress which has been made by the three-year-old Certified Lighting Program, Bureau Manager L. C. Messick reported that 18 bureaus are now in operation.

LIGHTING course sponsored by the Western New York Section has registration of 43. Course was under the direction of J. F. Parsons, Chairman of the Section's Special Activities Committee.

AT THE 1956 Conference on Color, Light and Design, sponsored by the Residence Lighting Forum of the Michigan Section, I.E.S., the speakers featured were: left to right, Professor Arre Lahti, H. Creston Doner, Miss Myrtle Fahsbender, E. W. Commery, Miss Mary Taepke, and Bruce Bradshaw.

Deadline — February 1, For 1957 Conference Paper Outlines

A deadline of February 1 has been set, by the I.E.S. Papers Committee, for outlines of proposed papers for the 1957 National Technical Conference. Outlines of proposed papers, in triplicate, should be mailed to:

H. F. Davidson, Chairman
I.E.S. Papers Committee
c/o Hydro-Electric Power Commission of Ontario
620 University Avenue
Toronto 2, Ontario, Canada

Michigan Residence Lighting Forum Reports on 1956 Conference

The report has been made on the Color, Light and Design Conference for 1956, sponsored by the Residence Lighting Forum of the Michigan Section. The second annual one-day meeting attracted 98 full registrants and 55 students. The sessions were held at the Detroit Edison Auditorium in Detroit and the program was as follows:

Welcome — Mrs. Mariquita Dygert, Home Service Division, The Detroit Edison Co.
Opening Remarks — Harry Robbins, Chairman, Residence Lighting Forum.

(*Continued on page* 14A)

DINNER meeting of the Central New York Section in October was held at the Link Aviation Plant, Binghamton, N. Y., with an attendance of 77 members and guests. After dinner slides of the plant and products were shown by Link engineers, followed by guided tours with demonstrations of the lighting and the manufacturing processes.

CHARTER of the newly-formed Yankee Chapter of I.E.S. is presented to Chapter Chairman Arthur C. Brodeur by R. F. Hartenstein. Presentation was made during the National Technical Conference in Boston last September.

(*Continued from page* 13A)

The Enigma of Design and the Consumer — Professor Arre Lahti, School of Architecture and Design, University of Michigan.
New Horizons of Color in Architecture and Design — H. Creston Doner, Director of Design, Libbey-Owens-Ford.
How to Create a Color Scheme — Bruce Bradshaw, J. L. Hudson Co.
Light and Lighting in the Home — E. W. Commery, General Electric Co.
Lighting for Family Living — Miss Mary Taepke, The Detroit Edison Co.
Modern Lighting Designs for Kitchens and Bathrooms — Miss Myrtle Fahsbender, Westinghouse Electric Corp.
Coordination of Decoration and Lighting in the Complete Home — E. W. Commery, General Electric Co.

Lighting Fundamentals Course Scheduled at McGill

A Fundamentals of Illumination course is scheduled to be given by the Department of University Extension, McGill University, Montreal, starting January 22, 1957. The ten two-hour lectures will be held at the college's Engineering Building. Fee for the course will be $20.

Eastern Utility Conference Sponsored by Holophane

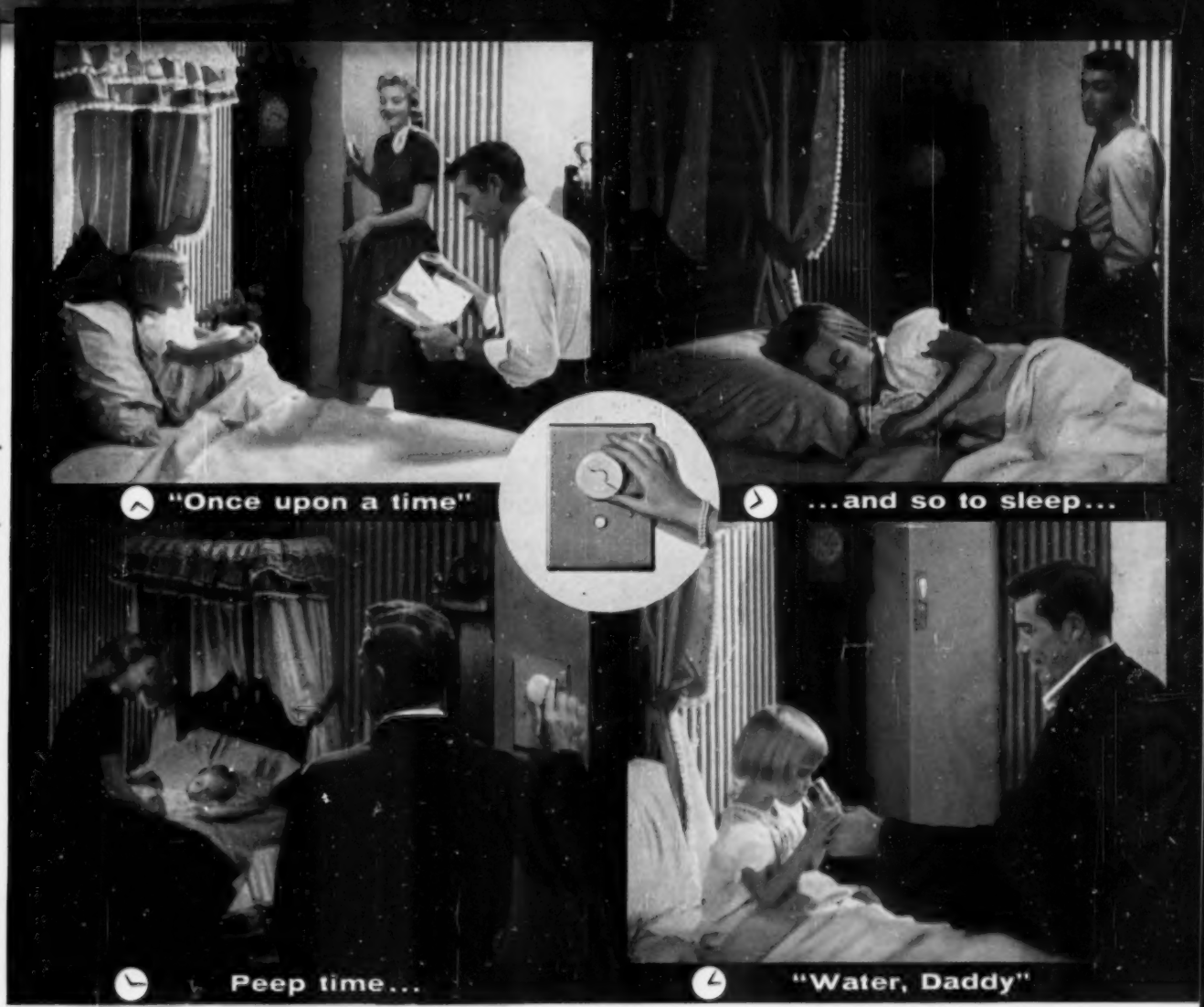
Twenty-four utility lighting engineers representing nine utilities in the states of Connecticut, New York and New Jersey, took part in a two-day Advance Engineering Conference at the Light and Vision Institute of the Holophane Co., in New York City October 30 and 31. The program covered current lighting trends, markets, and engineering features of design and application, ending with a seminar on "Relations among Electric Utilities" which was held at the Edison Electric Institute New York headquarters.

(*Continued on page* 17A)

At the Utility Conference, October 30-31.

T. M. Barr, H. A. Hutchinson, C. W. McCormick.

J. F. Dickerhoff, R. O. Mills, E. R. Drechsel.



The new age of lighting is here!

Specify LUXTROL Light Control!

Only once in a long, long time does something as dramatically new as LUXTROL Light Control come your way!

Take full advantage of this new concept . . . to dress up your clients' homes with light. To give them extra distinction and appeal!

LUXTROL Light Control creates any level of light . . . from dark to full bright! Just by turning a dial!

Look at the nursery scenes above. How easy it is, with LUXTROL, to dial just the right light for reading. How gradually, gently, you can diminish light . . . to put a child in the right mood for sleep.

Notice how you can dial a soft light for baby-checking. Or get a slightly higher level of light for answering "night calls".

The nursery, here, is used only as an example. It is just one of many rooms where LUXTROL gives lighting convenience and decorative effects never dreamed of before. Actually, LUXTROL can be used to advantage in every room in a house.

LUXTROL is a cool, efficient autotransformer . . . not a rheostat. It is precision-engineered . . . silent . . . safe. Approved by Underwriters' Laboratories. Low-cost.

Consult your electrical contractor for all the facts about LUXTROL Light Control. We'll send you **LUXTROL** literature. Mail the coupon.

THE SUPERIOR ELECTRIC COMPANY
4126 Demers Ave., Dept. I
Bristol, Connecticut

Please send me full design data on new LUXTROL *Light Control . . . and the names of electrical contractors in my area.*

Name_____
Street_____
City_____ Zone____ State_____

Eastern RECTILINEAR ILLUMINATION

GIVES TROFFER APPEARANCE —
TROFFER LIGHTING PATTERNS —
without
TROFFER EXPENSE

Available with
PLASTIC DISH TYPE LENS
OR
PLASTIC LOUVER
WITH

2 or 4 40-Watt T12 Rapid Start Lamps
or
4 20-Watt T12 Trigger Start Lamps

These 2 Eastern units unquestionably represent the year's first advancement in commercial lighting. Here you have abundant, glare-free illumination from a unit that is less than 3" deep. In addition, virtually every geometric lighting pattern known to engineering can be achieved with these units, yet the cost is far less than a troffer installation.

Before you buy lighting, be sure to get the facts about Eastern's Rectilinear Illumination — you'll be glad you did.

Eastern ENGINEERED

EASTERN FIXTURE COMPANY
170 VERNON STREET, BOSTON 20, MASSACHUSETTS

(Continued from page 14A)

This is the second of such meetings, the first being held at the Holophane Engineering Center in Newark, Ohio, for midwest utility personnel.

Rochester Section Celebrates Tenth Anniversary

The tenth anniversary of the Rochester Section, I.E.S., was celebrated October 8 with a dinner-dance honoring the past-chairmen of the Section and highlighted by a talk by President Marshall N. Waterman. Mayor Peter Barry of Rochester also attended, as did 130 other guests and members. The dinner was held at the Hotel Rochester.

TENTH Anniversary of the Rochester Section was observed with a dinner-dance October 8. Seated at the head table are: R. Bruce Thompson, Section Chairman; Mrs. Thompson; Mayor Peter Barry; Mrs. Kridel; Norman T. Kridel, and I.E.S. President Marshall N. Waterman. Past-Chairmen of the Section, with their wives are seated at the two round tables directly in front of the head table.

ABOUT PEOPLE

Day-Brite Lighting, Inc., St. Louis, Mo. announces the appointment of **James F. Whitehead** as Executive Vice-President of the company, and **George J. Taylor** as Vice-President in charge of Eastern Operation. Mr. Whitehead was formerly Vice-President in charge of Sales and Mr. Taylor was Eastern District Sales Manager. Both men are active in I.E.S., Mr. Whitehead having recently served as Director and Mr. Taylor currently being the Society's Junior Vice-President.

Sylvania Electric Products, Inc., Lighting Division, has formed a new sales organization for fluorescent lighting fixtures, headed by **Richard G. Slauer,** recently named fixtures sales manager for lighting products. Reporting to Mr. Slauer are five area sales managers: **C. J. Kelleher,** northeast area, headquartered in Salem, Mass.; **Paul P. Harrison,** southeast area, Atlanta, Ga.; **Robert L. Kuschwa,** central area, Chicago; **John G. Felton,** southwest area, Dallas, Texas; and **Robert J. Delander,** western area, San Francisco.

INCOMING Chairman of the Rochester Section, R. Bruce Thompson, is sworn in on the I.E.S. bible (the *I.E.S. Lighting Handbook*), obligingly held by Peter Barry, Mayor of Rochester. President Marshall N. Waterman officiates at the ceremony and other participants are Fred Schmidt; Norman T. Kridel, Chairman of the Special Meeting, and William S. Barclay, a recent past-Chairman of the Section.

Establishment of a subsidiary company in Canada has been announced by Sola Electric Co., Chicago. The newly-formed company, Sola Electric (Canada) Ltd., is headed by **J. R. McGovern,** Managing Director. Mr. McGovern, who has been a District Sales Engineer with Sola for the past two years, will be located at the new company's address, 102 Laird Drive, Toronto 17, Ont.

Morris D. Hooven, of Montclair, N. J., former president of the American Institute of Electrical Engineers, was elected president of the Engineers Council for Professional Development at the 24th annual meeting of that group in Detroit October 25.

Announcement of the formation of a new architectural and engineering firm in Florida has been made recently. **J. Brooks Haas,** architect; **George R. Register,** mechanical engineer; **Morris V. Cummings,** electrical engineer; and **James N. Hutchinson,** civil engineer, have formed the firm of Haas, Register, Cummings & Hutchinson, Architects & Engineers. Their office is located in the Haas Building, 115 Park St., Jacksonville, Fla.

Louis L. Nealon has been appointed district sales manager of the Belmont district for the Lamp Division of Westinghouse Electric Corp. The Belmont district comprises Maine, New Hampshire, Vermont and eastern Massachusetts. Mr. Nealon will make his office at the com-

(Continued on page 18A)

SCHEDULED EVENTS

1956

December 13, 1956 — I.E.S. Council Meeting, New York, N. Y.

1957

January 16-18, 1957 — Society of Plastics Engineers, Thirteenth Annual Technical Conference, Hotel Sheraton-Jefferson, St. Louis, Mo.

January 21-25, 1957 — American Institute of Electrical Engineers, Winter General Meeting, Hotel Statler, New York, N. Y.

January 28-31, 1957 — Plant Maintenance & Engineering Conference, Public Auditorium, Cleveland, Ohio.

February 14, 1957 — I.E.S. Council Meeting, New York, N. Y.

February 17-20, 1957 — National Electric Sign Association, Annual Convention and Exhibit, Sheraton Park Hotel, Washington, D. C.

February 25-28, 1957 — American Society of Heating and Air-Conditioning Engineers, 63 d Annual Meeting, Chicago, Ill.

February 25 - March 1, 1957 — 13th International Heating and Air-Conditioning Exposition, Chicago, Ill.

March 11-14, 1957 — National Electrical Manufacturers Association, Edgewater Beach Hotel, Chicago, Ill.

March 28-29, 1957 — Pacific Northwest Regional Conference, Illuminating Engineering Society, Empress Hotel, Victoria, B. C.

April 3-5, 1957 — South Pacific Coast Regional Conference, Illuminating Engineering Society, Hotel Statler, Los Angeles, Calif.

April 8-11, 1957 — Fourth National Electrical Industries Show, 71st Regiment Armory, New York, N. Y.

April 11-12, 1957 — Inter-Mountain Regional Conference, Illuminating Engineering Society, Alvarado Hotel, Albuquerque, N. M.

April 18, 1957 — I.E.S. Council Meeting, New York, N. Y.

April 28-30, 1957 — Southwestern Regional Conference, Illuminating Engineering Society, Holiday Inn, Oklahoma City, Okla.

April 28 - May 3, 1957 — Society of Motion Picture and Television Engineers, Shoreham Hotel, Washington, D. C.

April 30 - May 2, 1957 — National Association of Lighting Maintenance Contractors, Conference, Kansas City, Mo.

May 6-8, 1957 — Air Conditioning and Refrigeration Institute, Annual Meeting, The Homestead, Hot Springs, Va.

May 9-10, 1957 — Midwestern Regional Conference, Illuminating Engineering Society, Hotel Pfister, Milwaukee, Wis.

May 13-14, 1957 — Great Lakes Regional Conference, Illuminating Engineering Society, Pantlind Hotel, Grand Rapids, Mich.

May 16-17, 1957 — Canadian Regional Conference, Illuminating Engineering Society, Hotel Sheraton Brock, Niagara Falls, Ont.

May 23-24, 1957 — East Central Regional Conference, Illuminating Engineering Society, William Penn Hotel, Pittsburgh, Pa.

June 4-6, 1957 — Chicago Electrical Industry Show, Conrad Hilton Hotel, Chicago, Ill.

June 12, 1957 — I.E.S. Council Meeting, New York, N. Y.

June 13-14, 1957 — Northeastern Regional Conference, Illuminating Engineering Society, Hotel Statler, New York, N. Y.

June 24-28, 1957 — American Institute of Electrical Engineers, Summer General Meeting, Montreal, Que.

August 26-30, 1957 — American Institute of Electrical Engineers, Pacific General Meeting, Yakima, Wash.

September 9-13, 1957 — Illuminating Engineering Society, National Technical Conference, Biltmore Hotel, Atlanta, Ga.

October 6-11, 1957 — Society of Motion Picture and Television Engineers, Hotel Statler, New York, N. Y.

October 7-11, 1957 — American Institute of Electrical Engineers, Fall General Meeting, Chicago, Ill.

October 21-25, 1957 — National Safety Council, 45th National Safety Congress & Exposition, Chicago, Ill.

November 11-15, 1957 — National Electrical Manufacturers Association, Traymore Hotel, Atlantic City, N. J.

November 18-21, 1957 — 10th Exposition of the Air-Conditioning and Refrigeration Industry, Navy Pier, Chicago, Ill.

OUTDOOR Parking Area Lighting was topic at the October 16 meeting of the Western New York Section. At the speakers' table, left to right, are Frank Wycoff; Roland Hepworth; Bruce Thompson, Chairman of the Rochester Section on a visit; Neal Jacobus, Moderator; Byron Lyth, Section Chairman; Al Shultz, and Jack Doyle.

(Continued from page 17A)

pany's sales office and warehouse at 30 Brighton St., Belmont, Mass.

Sylvania Electric Products Inc. has named **William L. Friend,** of Los Angeles, as Pacific Coast regional sales manager for their Lighting Division. Mr. Friend, in turn, has appointed **Thomas J. Holland** as district sales manager for lighting in the Seattle area, and Mr. Holland has named **Garland R. Barlogi** to the post of district sales supervisor — lighting in the Portland area. For the Los Angeles area, Mr. Friend has named **J. Clayton Stephens** as district sales manager, and **Charles H. Connely** has been appointed assistant district lighting sales manager.

Another Sylvania appointment, in their Midwest region, is that of **Marvin V. Schylling** to the post of district sales manager in the St. Louis area.

Ralph L. Huse, formerly district manager of lighting sales, Graybar Electric Co., has joined the Holophane Co., Inc. as Assistant to the New England District Manager, E. J. Perkins.

The Miller Co. has announced the appointment of **Don W. Houser** as sales representative for the Columbus-Central Ohio territory. Mr. Houser was formerly with the Ohio Oil Co. in a sales and administrative capacity.

Norman H. Scott has been named representative for Wakefield Lighting Ltd. in Toronto, Ont. For the past five years, Mr. Scott has been Sales Supervisor for D. H. Howden & Co., electrical distributors in London, Ont.

A four-way personnel change in the sales organization of General Electric's Lamp Division has been announced. **George E. Nelson,** manager of Large Lamp Northern Sales District for 27 years, and with G-E for more than 37 years, has retired in accordance with the company's pension plan. Named to succeed Mr. Nelson as manager of the Northern Sales District is **Michael C. Finn.** Mr. Finn has been Sales Manager of the division's Photo Lamp Mid-States Sales District with headquarters in St. Louis. Advancing to succeed Mr. Finn at St. Louis is **William J. Speckerman,** who has been serving as Large Lamp Retail Sales Specialist at division headquarters at Nela Park, where he is being succeeded by **William M. Kirkpatrick,** formerly Sales Promotion Specialist for the Buckeye Sales District.

(Continued on page 20A)

THE LIGHTING SYSTEM THAT
goes together on the floor

...and saves 50% on Installation costs

The new Gibson ORTHO Fixtures mount on a special channel called the UNI-RACE. In the photo above, the telescoping sections of the UNI-RACE are being assembled on the floor in a matter of minutes. The receptacles which come with each 4-foot section are connected as shown in the inset. The light but rigid UNI-RACE in 24′ to 48′ lengths is easily lifted and hung directly on joists, beams or stems. The fixtures simply snap into place on the UNI-RACE which holds them in perfect alignment.

An easier, faster and far better job! Is it any wonder that contractors report savings of more than 50% in labor and materials on Gibson ORTHO Installations?

Wouldn't you like more information about this totally new concept in industrial and commercial lighting design? Drop us a line today. We'll send you the whole story.

SNAP—IT'S UP • Connection is made through a built-in plug in the fixture which engages the receptacle in the UNI-RACE. Any fixture may be put up or taken down at will without interrupting other fixtures on the circuit.

VARIABLE SPACING • ORTHO units may be mounted in continuous rows or spaced at intervals of 4, 8, 12 or more feet. Fixtures may be added, removed and rearranged any time by one man without tools.

Model 77-424X

ortho-77 COMMERCIAL

Model 88-221X

ortho-88 INDUSTRIAL

® AND PAT. PENDING

Gibson LIGHTING

GIBSON Manufacturing Co.

Open Letter to I.E.S. Members

Your National Membership Committee is now well into its third month of operation. The results so far are encouraging, but have we really tapped the tremendous potential that each of us has to gain new members for our Society?

The goal of the National Membership Committee for 1956-1957 is three-fold:

(1) A gain of 2420 new members,
(2) A loss of not more than 600 members,
(3) An increase in the number of full-grade Members.

Each Section and Chapter is expected to increase its local membership by not less than 20 per cent. Several Sections and Chapters are already approaching that goal and one has, indeed, exceeded the goal within the month of October (the Chinook Chapter).

The 1956-1957 National Membership Committee is made up of all Section and Chapter Membership Committee Chairmen, plus the following:

Members-at-Large

Charles Amick, St. Louis, Mo.
R. M. Johannesen, Greensboro, N. C.
T. W. Lauer, Philadelphia, Pa.
Gerald Marks, Skokie, Ill.
M. J. Myers, Tulsa, Okla.

Regional Membership Representatives

Canadian Region — W. J. Montshone
East Central Region — J. B. McNall
Great Lakes Region — C. C. Munroe, Jr.
Inter-Mountain Region — G. B. Buck
Midwestern Region — Al Kurtzon
Northeastern Region —
Pacific Northwest Region — Blair Plowman
South Central Region — J. M. Gensburger
South Pacific Coast Region — W. W. Weiss
Southeastern Region — Wesley F. Johnson
Southwestern Region —

Each of the above ten men, plus the Regional Vice-Presidents and your National Officers, is most anxious to lend his help to your individual efforts. Most of the members of this Committee have already performed exceptional services in the interest of our Society.

It is not possible to single out all of the Sections and Chapters which are doing an aggressive job on individual membership, but at least a few deserve recognition. The Chicago Section with Eric Church as Chairman and Clarence Clarkson as Membership Chairman has come up with a program which can not help but have big results. The Philadelphia Section with Bill Mackinney as Chairman and A. S. Turner, Jr., as Membership Chairman, also have a campaign planned that will bring big results. The Michigan Section with Harry Robbins as Chairman and Bill Munroe, Jr., as Membership Chairman just came through with an excellent report. Dudley Moore, Chairman of the Oregon Section sent to the National Membership Committee a most encouraging report on their activity; and Mark Lee, Membership Chairman with Ford Bates, Chairman of the Cornhusker Chapter, report an active campaign already underway.

Let's get 75 Sections and Chapters working just as hard, and then we can make this year a completely successful year for our Society in new members gained. Thanks in advance for lending your individual help to this important phase of our Society's operation.

BROOKS CHASSAING, *Chairman,*
National Membership Committee

MONEY, money, money — winners of the membership contest in the Western New York Section receive checks from Bob Herget (center), membership chairman. At left is Will Hayes, first place, and at right is Byron Lyth, second. Third place winner, not shown, is Lon Meredity.

(*Continued from page* 18A)

Julius H. Hagenguth, manager of General Electric's High Voltage Laboratory in Pittsfield, Mass., has been appointed manager of high voltage research.

Arthur A. Berard, president, Ward Leonard Electric Co., and **V. Robins Tate,** executive vice-president, Perfex Corp., received the James H. McGraw Award, Electrical Manufacturers Medal and Purse at the annual meeting of the National Electrical Manufacturers Association on November 14 in Atlantic City.

The appointment of **Robert D. Barr** to the position of general sales manager of the large lamp department of Westinghouse Electric Corp. has been announced. Mr. Barr who joined the company in 1933, was most recently assistant general sales manager.

Carl S. Long, Jr. has been named lighting sales manager of a newly-established Rocky Mountain district of Sylvania Electric Products Inc. Mr. Long will make his headquarters at the company's new office at 4700 East 48th Ave., Denver.

The appointment of **Chalmer J. Carothers, Jr.,** to handle national sales of mercury vapor lamps for Sylvania Electric Products Inc.'s lighting division has been announced. In addition, Mr. Carothers, as product sales manager, will head up national sales of fluorescent lamp starters, fluorescent sign tubing, telephone switchboard lamps and transformers for use in electronic equipment. He will make his headquarters at the lighting division's Salem, Mass., offices.

Deaths

A. L. Clark, Toronto Section
John M. Cole, New York Section
Harold Y. Crounse, New York Section
E. Way Flaharty, Maryland Section
Mortimer Freund, New York Section
W. A. Munding, Mid-South Chapter
Joseph P. Orzech, New York Section
Gordon R. Shuck, Puget Sound Section
Russell L. Test, Tar Heel Section
Lawrence Voss, St. Louis Section

NEW MEMBERS

At the meeting of the I.E.S. Council Executive Committee held at New York, N. Y. on November 8, 1956, the following were elected to membership. Names marked * are transfers from Associate Member grade.

ALABAMA SECTION

Associate Member:
Steele, R. D., Alabama Power Co., Birmingham, Ala.

(*Continued on page* 40A)

GENERAL ELECTRIC ANNOUNCES THE MOST SIGNIFICANT DEVELOPMENT IN BALLAST DESIGN SINCE THE INTRODUCTION OF THE CERTIFIED SLIMLINE BALLAST

Important news for:

- FIXTURE MANUFACTURERS
- ARCHITECTS
- CONSULTING ENGINEERS
- ELECTRICAL CONTRACTORS

Progress Is Our Most Important Product

GENERAL ELECTRIC

Read about this exclusive G-E ballast design achievement and the complete line of G-E ballasts for slimline applications on the next 3 pages . . .

NEW G-E SHALLOW-HEIGHT BALLAST

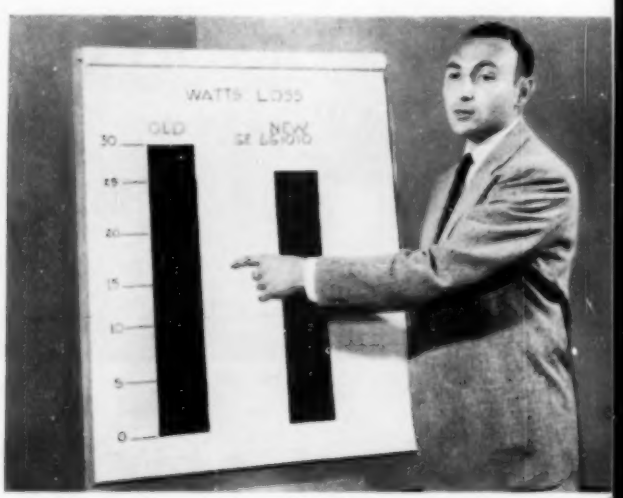
"Three years ago they said it was impossible to design this ballast!"

But General Electric did it. A small group of General Electric Ballast Department engineers accepted the challenge. Result: the G-E 6G1010 shallow-height ballast. This new ballast is smaller, lighter, more efficient and better insulated than any other ballast now available for 430 ma 96T12 slimline two-lamp applications. Moreover, it's the quietest ballast of its rating on the market today.

Electric and magnetic circuit innovations, the solution of heat transfer problems, and more efficient use of material and manufacturing technology helped to make this new design possible.

Dan Lovinger, Project Engineer of the General Electric Ballast Department, was one of those primarily responsible for the successful completion of the new design. In an interview, Mr. Lovinger outlines the features which make the 6G1010 the smallest, quietest, most efficient shallow-height ballast of its kind.

SMALLEST SIZE "The new 6G1010 shallow-height ballast is only $1\frac{3}{32}$" high by $3\frac{1}{16}$" wide—this, we think, is the optimum cross-section—with an over-all length of $11\frac{3}{4}$" and a mounting length of $11\frac{5}{64}$". That's small for a ballast of this type. It means fixture manufacturers and architects gain the ultimate in design freedom. We've reduced the weight of this new ballast, too. But rated light output, starting current and open circuit voltage have all been maintained in accordance with CBM specifications. Engineering innovations, improved manufacturing technology, and more efficient utilization of material made today's General Electric 6G1010 certified ballast possible."

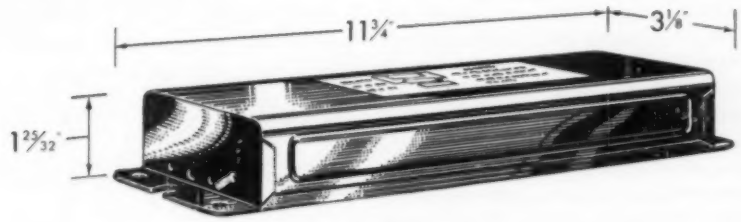


MOST EFFICIENT "Besides being the smallest size, the new 6G1010 ballast is also the most efficient ballast of its type. This high efficiency, achieved through certain design innovations, results in the lowest watts loss and operating temperatures known in the industry for a certified two-lamp 96T12-430 ma ballast. The watts loss value in the 6G1010 is only 26 watts. Because of this reduction in watts loss, we were also able to obtain low operating temperatures. Thus, greater design flexibility is possible for fixture manufacturers and architects which, to the ultimate user, means more efficient, more economical lighting applications. Low operating temperatures mean longer ballast life, too."

FOR 96T12 TWO-LAMP APPLICATIONS

You get four big advantages with the new General Electric 6G1010 shallow-height ballasts:

1. SMALLEST SIZE
2. MOST EFFICIENT
3. NEW INSULATION
4. QUIETEST OPERATION



GENERAL ELECTRIC

NEW INSULATION "We've also incorporated the best insulation system possible into our new 6G1010 ballast design. This new system includes the replacement of hygroscopic (water absorbing) insulation with Mylar* insulation and the introduction of nylon coated wire. Mylar insulation and nylon coated wire give greater dielectric strength and offer longer life characteristics. We've run field and laboratory tests which show that heat aging characteristics for nylon coated wire are far superior to any class "A" insulated wire for ballast applications. To supplement this excellent insulation system, the core and coil is pressure vacuum treated to give still greater dielectric strength and longer life."

*Registered Trade-mark of the DuPont Co.

QUIETEST OPERATION "The 6G1010 ballast offers the lowest sound rating in the history of two-lamp 96T12-430 ma ballasts under the exclusive G-E sound rating system. This is an extremely important feature and—we feel—a real achievement. The new G-E ballast is rated "C" which is at least one rating better than any two-lamp 96T12 ballast on the market. The developments which made this possible include the three piece core assembly with special push-on clamps, reduced core length, filling of shunt gaps with cement, special coil wedges, and our lift-pour with potting compound. Through these developments, we have been able to control and reduce vibration—the principal noise-causing factor.

WITH THE ADDITION OF THE 6G1010, GENERAL ELECTRIC INTRODUCES THE FIRST

COMPLETE LINE OF SHALLOW-HEIGHT BALLASTS FOR SLIMLINE APPLICATIONS

- **Standard 1-25/32" height allows greater fixture design flexibility**
- **One to four pound weight savings across complete line**

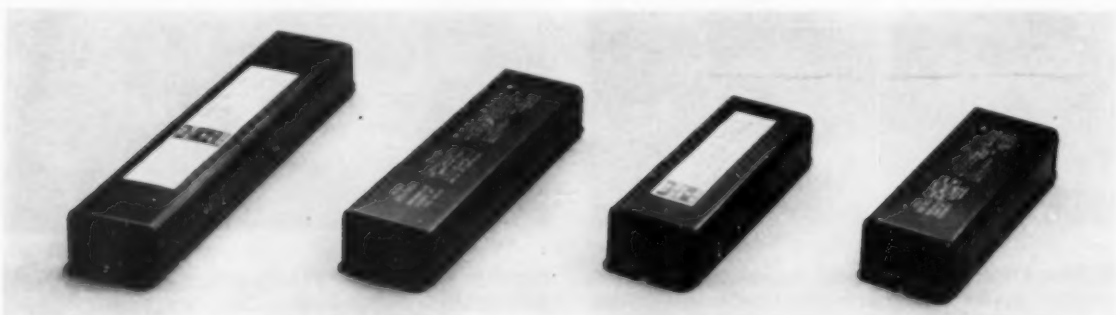
General Electric's complete line of shallow-height ballasts for slimline lamp applications enables fixture manufacturers to standardize on a shallower fixture channel. The shallow-height—$1\frac{25}{32}$ inches—as well as the generally smaller over-all dimensions makes possible greater design flexibility in fixtures and in architectural planning.

Weight reductions—ranging from one to four pounds—allow savings on fixture shipping costs. Mylar insulation and nylon coated wire give greater dielectric strength and longer life to all ballasts in this complete line. Quieter operation and increased efficiency are two other factors which can't be overlooked when specifying or ordering ballasts for slimline applications.

Choose the General Electric shallow-height ballast to fit your specific requirements. All units, of course, incorporate all of the General Electric standard "Quality" features—Exclusive Sound Rating System, Superior Quality Control, Longer Ballast Life, Lamp-Matched Design, Proved Product Leadership, Complete Customer Services.

For more information on the complete shallow-height line and all other G-E ballasts, write for bulletin GEC-983 to Section 401-32, General Electric Company, Schenectady 5, New York; or call your nearest G-E Apparatus Sales Office.

Catalog number	6G1010	89G600	89G662	89G693
Lamp types	96T12	48T12	96T12	48T12
Number of lamps	2	2	1	1
Circuit voltage	110-125	110-125	110-125	110-125
Frequency	60 cycles	60 cycles	60 cycles	60 cycles
Watts loss	26	20	27	20
Sound rating	C	D	D	D
Over-all length	11-3/4	9-1/2	14-5/16	9-1/2
Mounting length	11-9/64	8-57/64	13-3/4	8-57/64
Height	1-25/32	1-25/32	1-25/32	1-25/32
Weight (lbs.)	8	5-1/2	9-1/2	5-1/2
Weight savings (lbs.)	1-1/2	2-3/4	1/2	4+



89G662 6G1010 89G693 89G600

Progress Is Our Most Important Product

GENERAL ELECTRIC

(1) I.E.S. LIGHTING HANDBOOK, Second Edition

LATEST! One volume, 987 pages. Published 1952. Complete revision of first edition includes basic information on all phases of lighting practice and technique, based upon recently developed standards. Contains 18 technical reference and application sections; complete appendices of information regularly used; 655 photos, drawings, lighting tables, charts; fully cross-indexed . . . over 4500 items. For use of lighting engineers and specialists, consultants, architects, designers . . . all who plan, install and manufacture lighting systems and equipment.

$8.00 per copy; $6.40 in lots of ten or more. Add 50c for shipment abroad. *I.E.S. Members are entitled to one copy of the Handbook at $5.50 unless previously ordered.*

I.E.S. RECOMMENDED LIGHTING PRACTICES

These booklets are the complete, standard recommendations for lighting the prescribed areas, and are among the most comprehensive and important of all Society publications. As indicated, some of these recommendations are the work of committees of the American Standards Association, with collaboration by appropriate committees of the I.E.S. All have the approval of the Council of the Illuminating Engineering Society, and are the latest official I.E.S. recommendations.

In general, the information contained in these Recommended Lighting Practices covers completely the area shown in the title. Included in the data are suggested types of lighting systems and luminaires; levels for general lighting and for specific areas; analyses of seeing tasks; and other information essential to lighting the area and of value to lighting engineers and specialists, architects, construction people and others. Each practice is fully illustrated with charts and photographs.

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I.E.S. Recommended Practice (1956) 50c

(3) STORES & OTHER MERCHANDISING AREAS
I.E.S. Recommended Practice (1948) 50c

(4) SCHOOL LIGHTING
American Standard Practice (1948) 50c

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I.E.S. Recommended Practice (1953) $1.00

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I.E.S. COMMITTEE REPORTS

Lighting recommendations based upon studies (research, surveys of current practice, and experimental installations) of I.E.S. Committees and Subcommittees covering all phases of lighting. Completely illustrated, these reports contain detailed information on many lighting problems peculiar to the industry or operation involved as well as providing general data as to lighting systems and luminaires; recommended quantity and quality of illumination; and analyses of specific seeing tasks.

The Publications of the Illuminating Engineering Society listed here summarize in printed form the vast amount of research, investigation and discussion of hundreds of qualified members of the Society working on technical committees. They contain the latest available information about many aspects of the art and science of illumination, including details of application as well as the lighting techniques involved. Each publication listed here is supported by the full authority and approval of the Illuminating Engineering Society.

I.E.S. Publications are available, in single copies or in bulk, to anyone requiring knowledge of the newest in lighting application and the supporting technical information. Published prices cover only the cost of production and handling. Quantity prices vary and are lower than the single-copy prices shown in this listing. Should quantities be desired for distribution, such as for educational or promotional purposes, prices may be obtained by writing Publications Office.

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Printed on heavy gloss paper, punched for standard ring binder, data sheets are an excellent "idea" file for lighting people, consulting engineers and architects; ideal for promotional distribution by manufacturers and light and power companies.

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Unchain your creative design ability...

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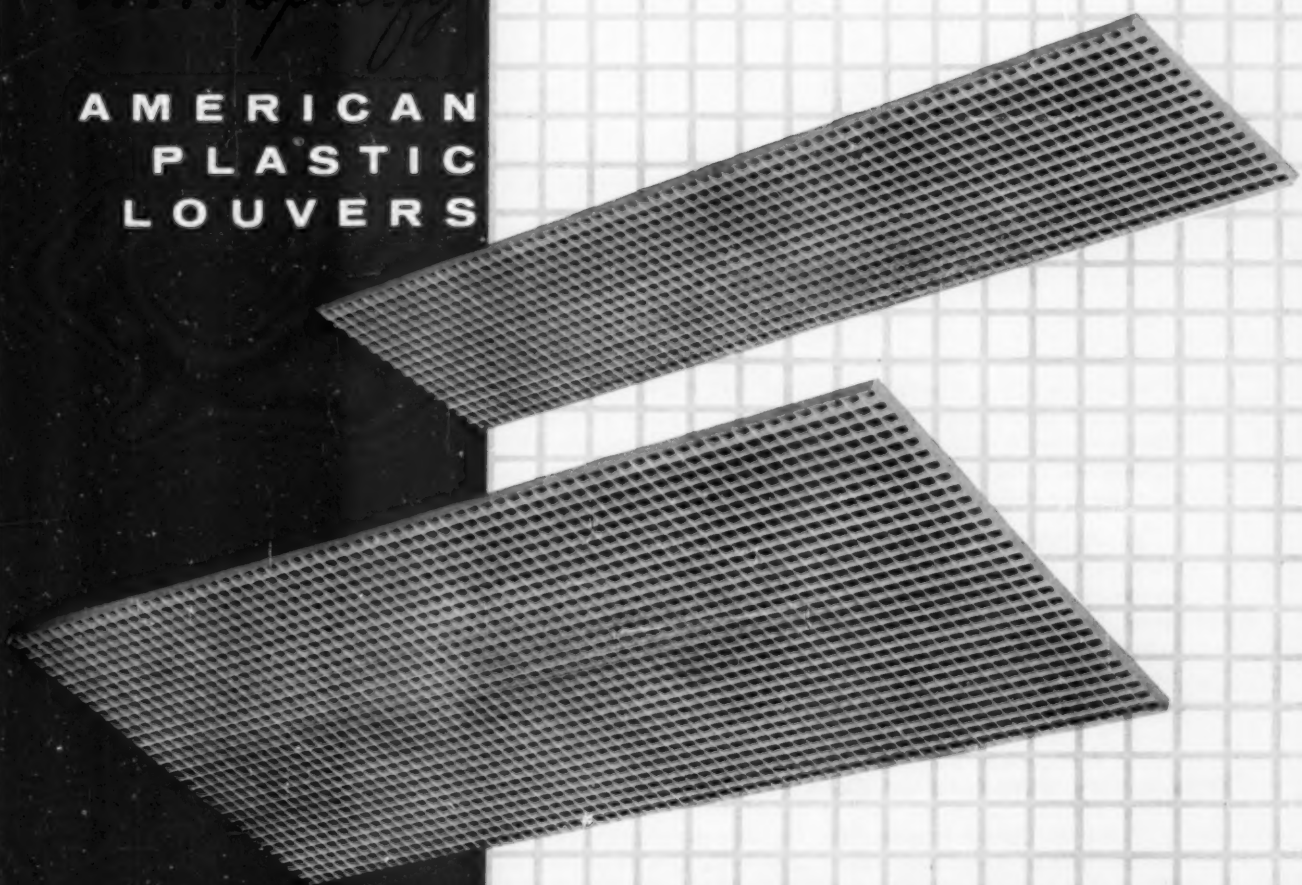
AMERICAN PLASTIC LOUVERS



Take advantage of the latest developments in modern lighting design. In American Louvers, total absence of welding, riveting, and surface brightness means exceptional versatility. They may be employed as single, recessed, or surface mounted units, continuous runs, or any combination of modular patterns, including over-all ceilings.

AMERICAN LOUVER COMPANY

4240 NORTH SAYRE

CHICAGO 34, ILLINOIS

Use Sola ballasts in your fixtures and you are assured immediate

"defective-in-warranty" replacement service, anywhere in the U.S.A.

Sola Electric Co. has launched a unique new ballast service plan. It enlists electrical wholesalers throughout the country as Sola Ballast Service Centers, *even though they don't stock Sola ballasts.* Electrical contractors are thus enabled to get an immediate, FREE certified CBM ballast replacement, from their regular local wholesaler, for any defective-in-warranty Sola ballast they bring in.

As an incentive to participate in the plan, qualified electrical wholesalers will be paid by Sola for their cost plus their full profit on the equivalent certified CBM ballast replacement, regardless of brand. Any qualified electrical wholesaler who stocks certified CBM ballasts for over-the-counter sale can participate in the plan. Sola also provides a variety of free promotional aids to wholesalers to advertise the service to their electrical contractor customers.

The quality standard of Sola ballasts

The Sola Ballast Service Plan is made possible because Sola ballasts have an exceptionally low failure ratio. Less than 14/100-of-1% of *all* Sola ballasts fail in-warranty, and less than 9/100-of-1% of Sola Rapid Start ballasts fail in-warranty. This unusually low failure ratio is due to Sola's very high standards of quality in engineering and manufacturing.

Here's how the plan works

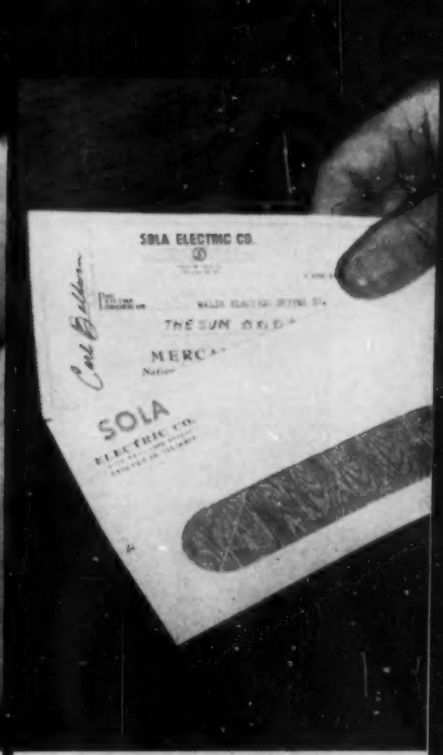
1. Should an electrical contractor anywhere in the U.S.A. find a Sola ballast which has failed in-warranty, he returns it to any qualified wholesaler who stocks Sola ballasts, or certified CBM ballasts of *any* make. The wholesaler checks the warranty date stamped on the ballast cover.

UL

CBM CERTIFIED by ETL

2. If the ballast failed within two years of the warranty date, the wholesaler gives the contractor another Sola ballast if he stocks them. If not, he refers to a ballast replacement guide provided by Sola to find an equivalent certified CBM ballast of another make which he stocks.

3. The wholesaler gives the new Sola ballast or the certified CBM ballast replacement to the contractor immediately, without charge. There is no red tape, no delay. The contractor merely signs a receipt and takes the replacement with him.



4. The wholesaler sends the receipt with his invoice to Sola Electric Co. Within 30 days, Sola sends him a check for his wholesale cost of the replacement ballast plus his usual profit on it, just as if he had *sold* it to the contractor.

Write for complete information

Most lighting fixture manufacturers are already familiar with the high quality and dependability of Sola fluorescent ballasts. This new Sola Ballast Service Plan is another tangible advantage which makes Sola ballasts your best choice for installation in your fixtures. You are assured that the ultimate user of your fixtures, regardless of location, will get quick ballast replacement service to restore his fixture to perfect operating order should a Sola ballast fail.

If you would like more information about this unique plan, write or call Sola Electric Co. If you wish, a sales engineer will call on you to give you any other information you may want to know about Sola ballasts or other products.

Sola has complete warehouse stocks on both coasts and in the Midwest for prompt shipment, and is represented by qualified sales engineers with offices in every principal marketing center in the U.S.A. In addition, a large number of qualified wholesalers in principal cities stock Sola ballasts. Now, Sola offers comprehensive in-warranty service coverage through thousands of other qualified wholesalers who stock certified CBM ballasts of other makes. Mail the coupon for complete information.

SOLA
Electric Co.
4633 W. 16th St.
Chicago 50, Ill.
Bishop 2-1414

TO: SOLA ELECTRIC CO.
4633 West 16th St., Chicago 50, Ill.

☐ Please mail a detailed explanation of the Sola Ballast Service Plan.
☐ Please have a Sola sales engineer call.

My name_____

My title_____

Company_____

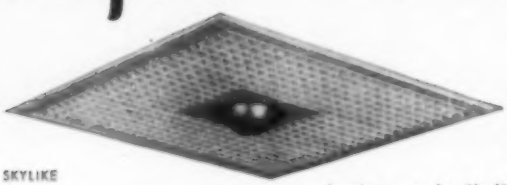
Address_____

City_____ Zone____ State_____

Piggly Wiggly, Inc. Supermarket, St. Louis, Mo. Owner and Operator: Wm. H. Brown

Skylike makes the most out of lighting in...

SUPERMARKETS



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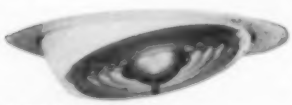


ADJUSTO SILVER-SPOT

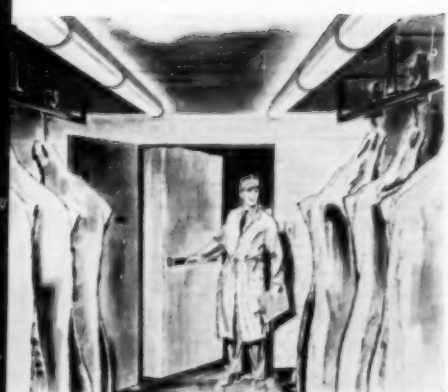
SILVER-DOT

Supermarkets have come a long way since the "box and crate days." Modern trends demand an unhurried atmosphere of cheerfulness, friendliness and pleasing color—to make shopping pleasurable—to increase buying moods. Skylike units supplemented by Silver-Dots are being used extensively by foremost designers to achieve this desirable result. Installations, as shown here, prove the effectiveness of their soft, glareless overall lighting combined with accent lighting in displaying foods at their tempting best and by inducing a leisurely selection of non-food, higher profit, traffic items.

If you are modernizing or planning new units it will pay to investigate the Silvray-Skylike line for supermarket lighting.

SKYLIKE LIGHTING, INC.
A SILVRAY ASSOCIATED COMPANY
RKO Bldg., New York • Bound Brook, New Jersey

Now... a luminaire that operates in freezing temperatures!



The new Westinghouse LT operates in low or variable temperatures — making it ideal for lighting cold storage warehouses, food lockers, shipping platforms and marquees.

Designed in cooperation with the Refrigeration Institute, the Westinghouse LT luminaire gives low heat output and high light output. A clear, ribbed plastic enclosure protects the lamp from air currents to insure maximum efficiency of the F72T-12, 100-watt, rapid-start lamps. In addition, the LT's porcelain finish resists corrosion in moist atmospheres and enhances its appearance. Why gamble with fixtures that were designed for other purposes.

Doesn't the LT suggest an application to you?

For real lighting quality, specify the Westinghouse LT luminaire.

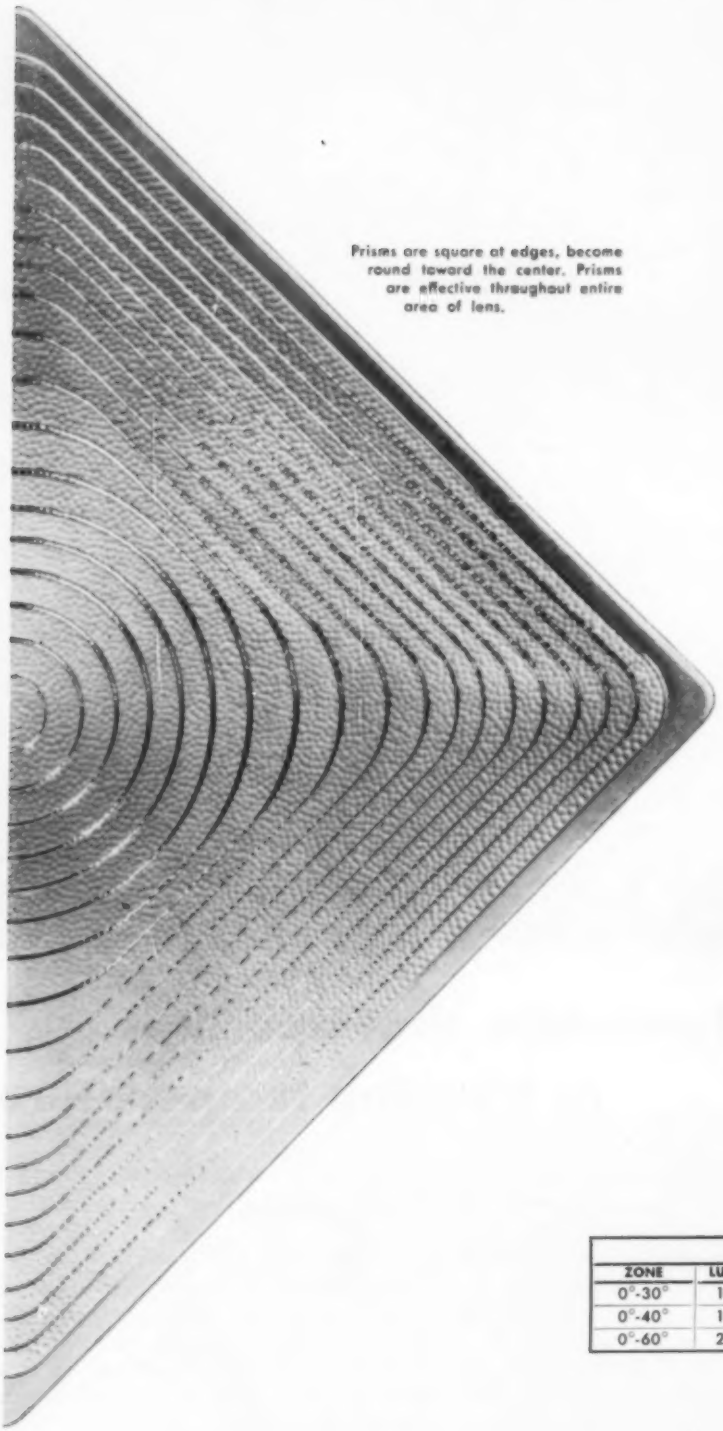
See your Westinghouse distributor or write, Westinghouse Electric Corp., Lighting Division, Edgewater Park, Cleveland, Ohio.

Look for other new Westinghouse lighting products . . . soon to be announced!

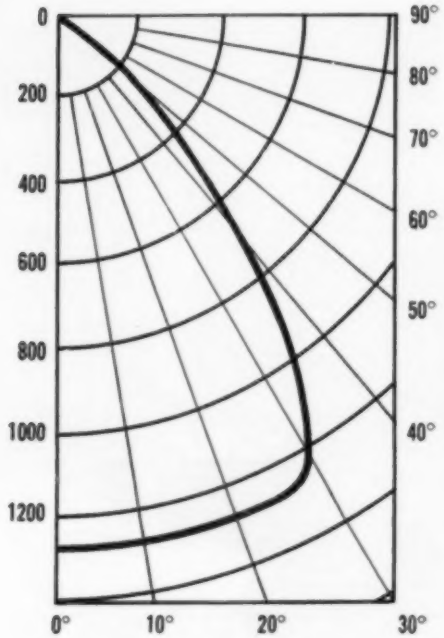
J-04399-B X

WATCH WESTINGHOUSE!

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***



Prisms are square at edges, become round toward the center. Prisms are effective throughout entire area of lens.



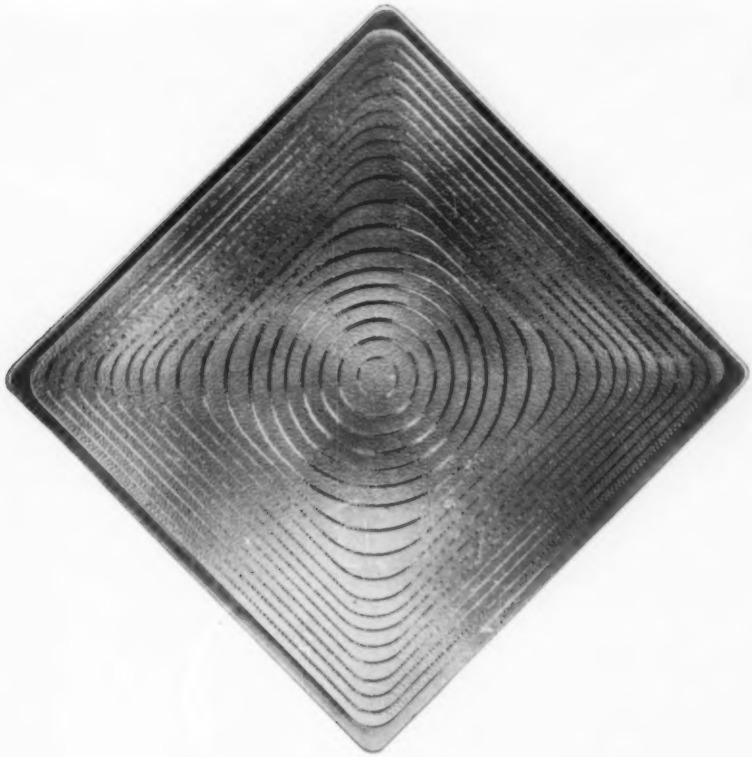
See the uniform light distribution you get with the new Corning Lenslite.

New Corning

CANDLEPOWER DISTRIBUTION DATA		
MID-ZONE ANGLES	AVG. CANDLE-POWER AT 40 FT.	ZONAL LUMENS
90° hor	0	
85°	2	2
75°	15	15
65°	54	53
55°	155	139
45°	396	306
35°	994	619
25°	1292	590
15°	1233	350
5°	1274	120
0° nadir	1280	

LIGHT FLUX VALUES					
ZONE	LUMENS	PERCENT	ZONE	LUMENS	PERCENT
0°-30°	1060	28.6	0°-90°	2194	59.3
0°-40°	1679	45.4	90°-180°	0	0
0°-60°	2124	57.4	0°-180°	2194	59.3

AVERAGE BRIGHTNESS			
ANGLE	Ft-L	ANGLE	Ft-L
85	82	55	962
80	123	50	1363
75	206	45	1992
70	312	40	3060
65	455	35	4314
60	676	30	5080



lenslite gives more even light distribution

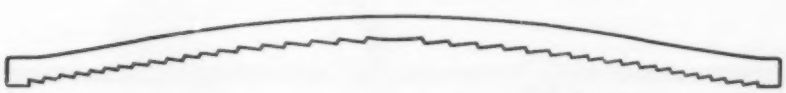
improved concave prismatic design for illumination without glare

Whenever you want to use incandescent lighting — for banks, stores, assembly halls—indoors or out—here is a new lens to consider.

Its concave design reduces the visible area of the lens at high angles. With an unusually high efficiency, the lens gets more light to the useful zone. It avoids sharp-angled beams of intense light. It gives illumination without glare.

Because it is made of a heat-resistant glass, you can use the new Corning lenslite indoors or out without fear of thermal shock.

For more information on this new development in Corning Engineered Lightingware write, wire or phone us.



This cross-sectional diagram shows the concave shape of the new Corning lens.

CORNING GLASS WORKS, 61-12 Crystal Street, **CORNING, N. Y.**

Corning means research in Glass

Another Bank gets that "Look of Prestige" Economically

with Lighting by LITECONTROL

Quiet elegance . . . maximum lighting efficiency at desk level — this installation of the Philadelphia National Bank, Lansdale, Pennsylvania, has *both*.

Time was when this type of impressive lighting represented a considerable investment. But no more! *Standard* Litecontrol fixtures held costs down here as they have elsewhere in many other bank, school, office and store installations.

Litecontrol series 3500RS rapid start troffers were used with Holophane low brightness lenses in hinged doors with Trigger Catches. Note how well the orderly but interesting rectangular fixture arrangement blends with the clean lines of the counters and furnishings.

"Litecontrol" is a good name to remember whether you specify, design or install lighting equipment — and quality, cost and upkeep *all* have to be right!

INSTALLATION:
Philadelphia National Bank, Lansdale Office, Lansdale, Penna.

DESIGNED BY:
The Cunneen Company, Philadelphia, Penna.

ELECTRICAL CONTRACTOR:
Swartley Brothers, Lansdale, Penna.

FIXTURES:
Litecontrol #3524RS and 3548RS (lamps in tandem) with Holophane #9018 lenses

INTENSITY:
55 Footcandles in Service

LITECONTROL *Fixtures*

KEEP UPKEEP DOWN

LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

SEATTLE ART MUSEUM/ARCHITECTS • YOUNG, RICHARDSON, CARLETON AND DETLIE, SEATTLE/DESIGNER • HARRY C. LYNDE CO., SEATTLE

HONEYLITE®

LIGHT-DIFFUSING ALUMINUM HONEYCOMB

A development of HEXCEL PRODUCTS INC.

951 SIXTY-FIRST STREET, OAKLAND 8, CALIFORNIA

THE FINE ART OF LIGHTING

Whether you're lighting priceless objects, not-for-sale . . . or merchandise priced for quick sale, Honeylite's gentle but completely shadow-free light makes "seeing" a pleasure.

But Honeylite doesn't stop at being just one of the very best light diffusing elements. Salespeople, and more important, customers will tell you that Honeylite's full air circulation makes a room as refreshingly airy as a summer morning . . . cool to work in, and fun to shop in.

And Honeylite's gossamer-weight, all-aluminum construction reduces the costly man-hours of installation, and lengthens the life of lighting units.

For price lists and detailed information call your dealer or write to Hexcel Products Inc., 951-61st Street, Oakland 8, Calif.

Now you can operate two H-1 400-watt outdoor mercury vapor lamps from a single Sola Constant Wattage Ballast

Operating advantages embodied in the Sola Constant Wattage Mercury Vapor Lamp Transformer have proved so desirable and practical that this type of ballast is fast becoming the generally-accepted standard for mercury vapor lighting installations. Now constant wattage operation plus the economy of two-lamp ballasting is available in a single Sola CW Mercury Vapor Lamp Transformer.

This new design is specifically for two-lamp, outdoor service in commercial and industrial applications of H-1 400-watt mercury vapor lamps. Its famous Constant Wattage Principle of operation offers users the following performance features:

- *Low starting current surge*
- *Regulated lamp wattage and light output*
- *Open circuit protection*
- *Elimination of need for primary taps*
- *No extinguishing on line voltage dips*
- *Extended lamp life*

For additional information on your particular application, contact your sales engineer listed below. He's one of a nationwide organization maintained by Sola Electric Co. to provide you with prompt service.

SOLA *Mercury Vapor Lamp* **TRANSFORMERS**

Write for Bulletin 3L-MV-244
SOLA ELECTRIC CO., 4633 W. 16th St., Chicago 50

CONSTANT VOLTAGE TRANSFORMERS • FLUORESCENT LIGHTING BALLASTS • MERCURY VAPOR LIGHTING TRANSFORMERS
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Sylvan-Aire Lighting System by Sylvania. Relighting job maintains high 80-foot candle lighting levels at table tops in Hawthorne High School's traditional-styled library. Rows of luminous plastic run between ceiling beams, are mounted flush with bottoms of beams. Installation by Tri-Service Electric Co., Paterson, N. J.

How they put good reading light into a Tudor library

... at Hawthorne (N. J.) High School

IN RELIGHTING the Hawthorne High School library, school architects S. E. Greydanus & Son (Paterson, N. J.) used a successful new approach. They specified Sylvan-Aire . . . Sylvania's wall-to-wall lighting system . . . had it divided into separate panels of light between ceiling beams. The rows of translucent plastic shielding were mounted flush with the bottoms of the ceiling beams.

Over-all effect: Clean, straight ceiling lines . . . a soft, even illumination spread over the entire floor area, blending with the traditional room décor.

Over-all result: Good reading illumination levels of 80 footcandles maintained in all parts of the room, including those corners most distant from windows . . . a true shadow-free, glare-free effect. Seeing and reading are easier, room atmosphere is more inviting and conducive to good work and study habits, desk lamps and reading lights become outmoded.

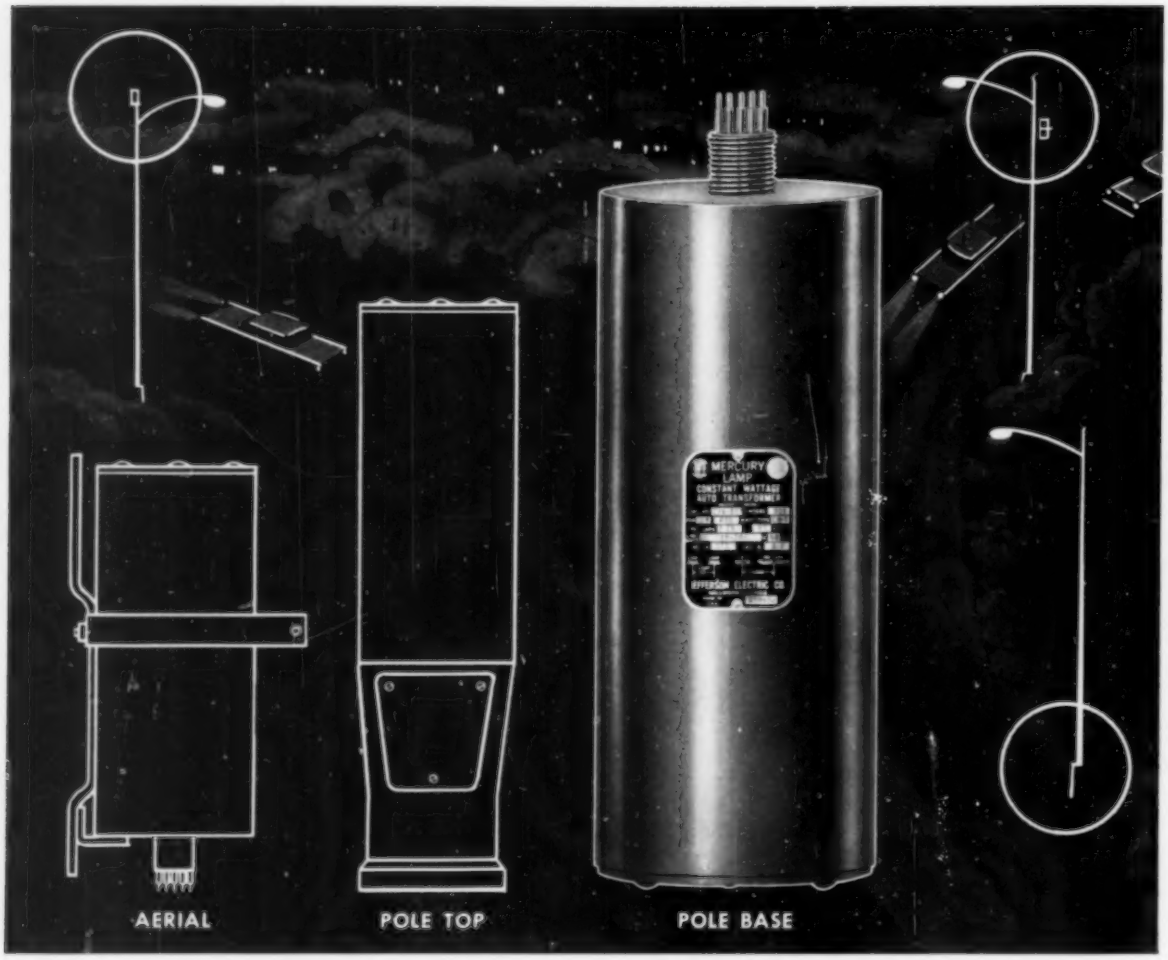
A complete lighting plan to fit your specific school needs can be tailored from Sylvania's complete line of lighting systems and fixtures. We suggest you talk to the Sylvania Lighting Specialist in your area. Or if you prefer, write direct for our free helpful booklet, "Some Whys and Hows of Modern School Lighting," or for other specific data.

SYLVANIA ELECTRIC PRODUCTS INC.
Dept. M 30, Lighting Division—Fixtures
One 48th Street, Wheeling, W. Va.

SYLVANIA

... fastest growing name in sight

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY



New! Jefferson Constant Wattage Mercury Lamp Transformer

New Electrically—New Mechanically

☆ **Stocking Requirements Cut in Half.** A new, slimmer shape and new mounting accessories make it possible to use this *one* transformer for aerial, pole top, or pole base applications.

☆ **Easier Handling in Warehouse and on the Job.** A one-inch reduction in diameter further simplifies the stocking problem and combines with the new threaded pipe nipple for *easy*, *fast* installation.

☆ **Improved Lumen Maintenance.** Engineered to produce a better starting current wave shape for smooth, quiet starts; plus an operating lamp current crest factor which meets *all* lamp manufacturers' requirements.

☆ **Dependable Operation.** Designed and tested to provide:

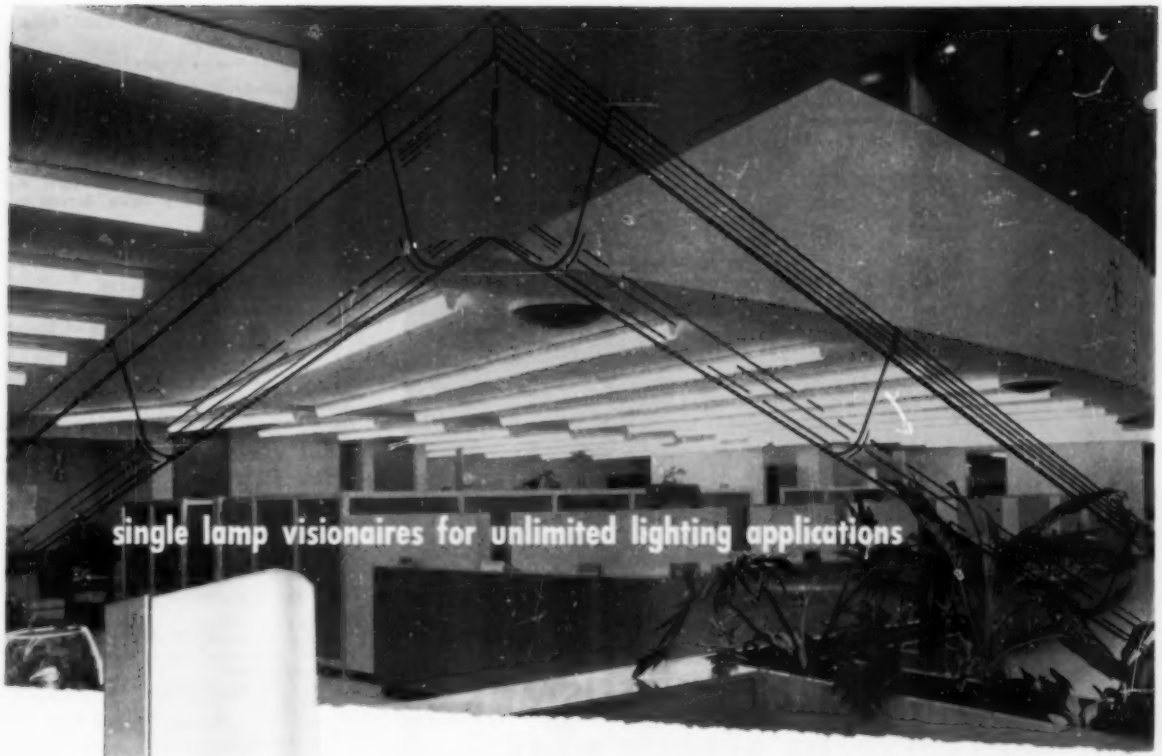
1. Constant lamp wattage of ±2% over line voltage range of ±13%.
2. *Automatic* compensation for line voltage variations and line drops.
3. Positive cold weather starting down to —30°F.

☆ **Maximum Versatility.** Designed for use with AH-1, EH-1, JH-1, and *all* similar 400 watt lamps. *These transformers are compensated to provide full rated light output in any lamp burning position consistent with lamp manufacturers specifications.*

For full details and experienced engineering recommendations, contact your Jefferson Representative or write JEFFERSON ELECTRIC COMPANY, Bellwood, Illinois, today.

Jefferson Electric Company

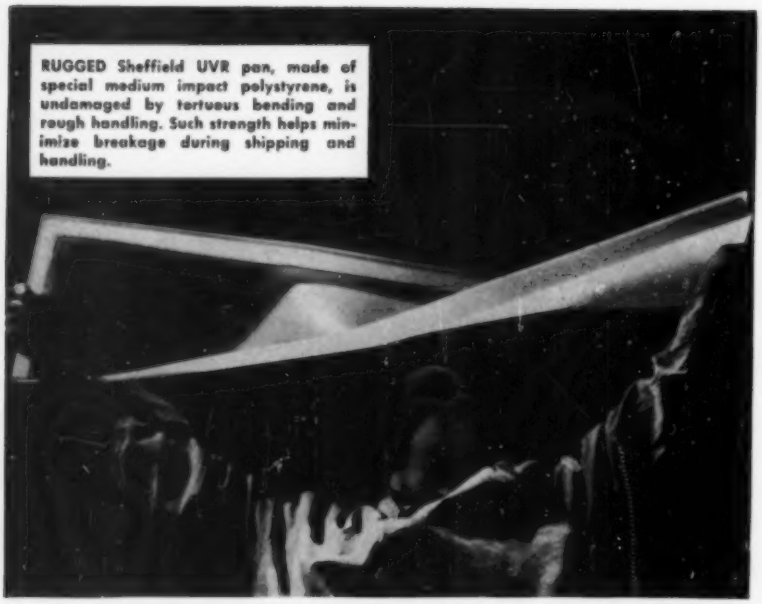
BELLWOOD, ILLINOIS



Here is versatile, shielded, single-lamp lighting for more applications than there's space to name with the Sunbeam P2801 Visionaire for corridors, library stacks, small parts bins, stairways, dressing rooms, over murals, paintings and commercial display areas or, as pictured, to form the general lighting system for smart contemporary interiors. Arrange patterns with the matching corner connector for uninterrupted geometric designs; follow contours or mount vertically on walls to provide local illumination. White plastic diffuser presents uniform surface brightness in all directions, snaps in or out with gentle "squeezing" motion. Low, low maintenance and tailored illumination distinction is assured whatever the application. Available in all standard lamp lengths.

SUNBEAM LIGHTING COMPANY

777 East 14th Place, Los Angeles 21, California


RUGGED Sheffield UVR pan, made of special medium impact polystyrene, is undamaged by tortuous bending and rough handling. Such strength helps minimize breakage during shipping and handling.

SHEFFIELD ANNOUNCES FIRST LIGHT-STABLE, BREAK-RESISTANT POLYSTYRENE PLASTIC PANS

Sheffield's new UVR pans for fluorescent lights resist breakage during handling and shipping, yet have a bright, white color comparable to regular high quality acrylic pans.

In addition, they have high light transmission (40% more than vinyl pans with the same hiding power) and extreme light stability.

Secret of their unusual property combination is a new formulation developed by Sheffield engineers, plus the addition of Sheffield's special ultra violet absorbing material. The latter helps the UVR pans maintain their color as much as 15 times longer than vinyl, 4 to 5 times as long as regular styrene materials.

UVR pans also have high hiding power, satin-smooth surface finish and dimensional accuracy.

The new pans make it possible for designers, engineers and architects to obtain the cost advantages of polystyrene without sacrifice of hiding power, appearance or light transmission.

Full details on Sheffield UVR pans are readily available. Write to Sheffield Plastics Inc., Section 161-4B, Sheffield, Mass., or contact your nearest Sheffield representative.

Precision Engineered Rigid Plastic Extrusions

SHEFFIELD PLASTICS
INC.
SHEFFIELD, MASS.

(*Continued from page 20A*)

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(Continued on page 42A)

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FLUORESCENT LIGHTING FIXTURE
Packed with Quality
Long before an L & P fluorescent light fixture is laid carefully into its carton—ready for prompt shipment to you—it is "packed" with quality. For quality is built right into every L & P fixture, every step of the way . . . from the precision-tooled dies made under our own roof to the last turn of a screw on our modern assembly line.
Such quality costs you no more—often less. Why not write or wire today for catalog and prices of the whole Light & Power line.
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LIGHT & POWER UTILITIES CORP.
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giving
life
to
light...

By giving to light the quality of motion — that is, by varying its intensity or its color, or both — you give it a life of its own: as different from ordinary artificial light as an orchestral flute is different from a one-note penny whistle. There are times and places when this sort of controlled light — living light — can be used with magical effect. Century makes every kind of device for controlling light and has a world of practical experience to share with you in how they are used

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(Continued from page 41A)

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BOOKS AND PAMPHLETS

A revised edition of **Electric Power Distribution for Industrial Plants,** and a new book, **Grounding of Industrial Power Systems,** have been announced by the American Institute of Electrical Engineers.

The latter book is, in effect, an extension of Chapter Five of "Electric Power Distribution for Industrial Plants," (known as the Red Book) being issued as a separate periodical.

The Red Book, which is a revision of

(Continued on page 44A)

I.E.S. National Technical Conferences

1957 — September 9-13 — Biltmore Hotel, Atlanta, Georgia

1958 — August 17-22 — Royal York Hotel, Toronto, Ontario

1959 — September 7-11 — Hotels Fairmont and Mark Hopkins, San Francisco, California

design by mcPhilben

A Recessed Weathertight Downlight

Good-looking, extra shallow, rugged . . . engineered for severe weather and corrosive conditions

Entrances, canopies, lobbies, vestibules, corridors, shower rooms . . . this extra shallow recessed downlight meets all your requirements . . . where appearance is important and non-corrosiveness vital.

FACE PLATE . . . of cast satin aluminum . . . is anodized for extra weather protection . . . features the new Sealume gasket to insure weather-tight operation within the lighting unit . . . simultaneously eliminates ceiling dust streaks and light leaks visible from without.

HOUSING . . . of 16 gauge galvanized . . . can either be used as a concrete pouring form . . . or mounted in recesses already provided by using wood forms. For plaster-type ceilings, use plaster frame. Attach hinged face plate and tighten screws so Sealume gasket is compressed tight against the ceiling.

IT'S AVAILABLE with round or square diffusers providing either symmetrical *or* asymmetrical light distribution from 60 Watts to 300 Watts . . . **extra shallow . . .** with corresponding depths from 2½" to 6¾". Protective guards, if desired. For full data on this series, write for the "43" line.

1353 Willoughby Avenue, Brooklyn 37, N. Y.

CONSULT mcPhilben Lighting SPECIFY

Representatives in major cities

Kopp Lenses

make air travel Safer

SUSTAINING MEMBER

Perhaps no business or industry is more aware of the importance of safety than air transportation. Both planes and airports are equipped with every practical device to insure safe take-offs and landings, and smooth danger-free flights en route.

For years Kopp Lenses have been contributing a significant role in safe airport operation. Here Kopp Lenses display their extreme dependability on every count—accurate beam control, color transmission, weather resistance and others.

If the continuous, safe operation of your products depends on lenses, sight glasses, color filters or other glass parts, you can depend on Kopp to provide the characteristics you need.

KOPP GLASS

KOPP GLASS, Inc.

Swissvale, Pennsylvania

BETTER LIGHT with Fewer Poles!

New Revere "4 in 1 Spectacular"

for large area illumination

Important Advantages of the "Ultra-Lite" LUMINAIRE...

- ★ A truly scientific and effective application of mercury luminaires producing a square light pattern
- ★ Provides abundant light for both vertical and horizontal surfaces
- ★ Achieves more light with fewer poles and fixtures
- ★ Gives the lighted area new impetus in attracting more trade
- ★ Reduces maintenance and repair costs

TYPICAL INSTALLATION

Mounts on Revere 30 foot Octagonal Rigid Poles or Revere No. 199-DB30 Hinged Pole. The Hinged Pole permits easy cleaning and maintenance without expensive elevator equipment.

Revere Ultra-Lites with their 52 inch spherical dome and four Mercury Luminaires offer an entirely new concept for large area lighting. They provide wider coverage, better vision and high efficiency coupled with a modern, distinctive appearance which makes them the most logical units for lighting of Shopping Centers and Parking Lots—Play Grounds—Amusement Centers—Beaches—Drive-ins, etc.

Write today for descriptive literature.

REVERE ELECTRIC MFG. CO. • 6009-17 BROADWAY • CHICAGO 40, ILL.

Available in Canada thru Curtis Lighting, Ltd., Leaside, Toronto, Ontario

THE ONLY COMPLETE LINE OF LUMINAIRES - FLOODLIGHTS AND POLES FOR STREET - SPORTS AIRPORT - SERVICE STATION - OUTDOOR THEATRE - MARINE AND INDUSTRIAL LIGHTING

(*Continued from page 42A*)

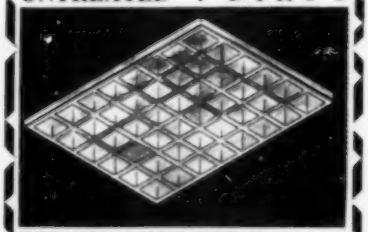
the edition first published in 1945, consists of 10 chapters on System Planning, Voltage Considerations, System Protection, Fault Calculations, Grounding Power Factor, Power Equipment, Instruments, Conductors and Terminators, and Relative Cost of Industrial Distribution Systems.

Both books are prepared by subcommittees of the AIEE Industrial Power Systems Committee. They are available from the AIEE, at $3.50 for Electric Power Distribution of Industrial Plants, and $1.20 for Grounding of Industrial Power Systems (50 per cent discount to AIEE members).

Why Good Voltage Means Consumer Satisfaction to Rural Electric Co-operatives, GED-3080 is available from the General Electric Co., Schenectady 5, N. Y. It is an 8-page illustrated booklet describing the effects of voltage variation on electrical equipment used by farm and home owners.

The ABC of Flash Photography is a single-sheet folder published by Westinghouse Electric Corp. and available, free, through dealers of photographic supplies.

UNTREATED : *DIRTY*



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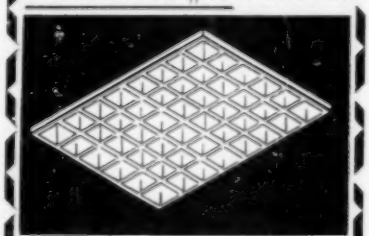

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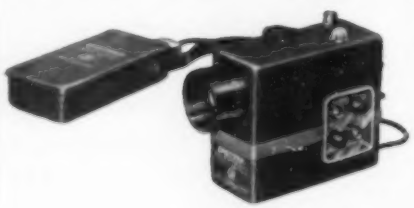

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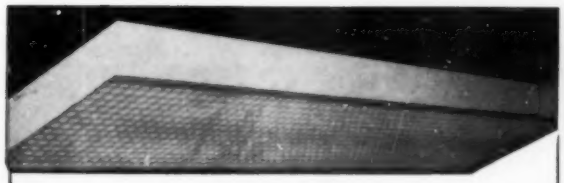

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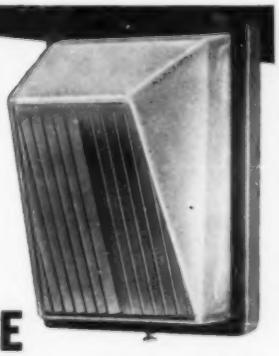

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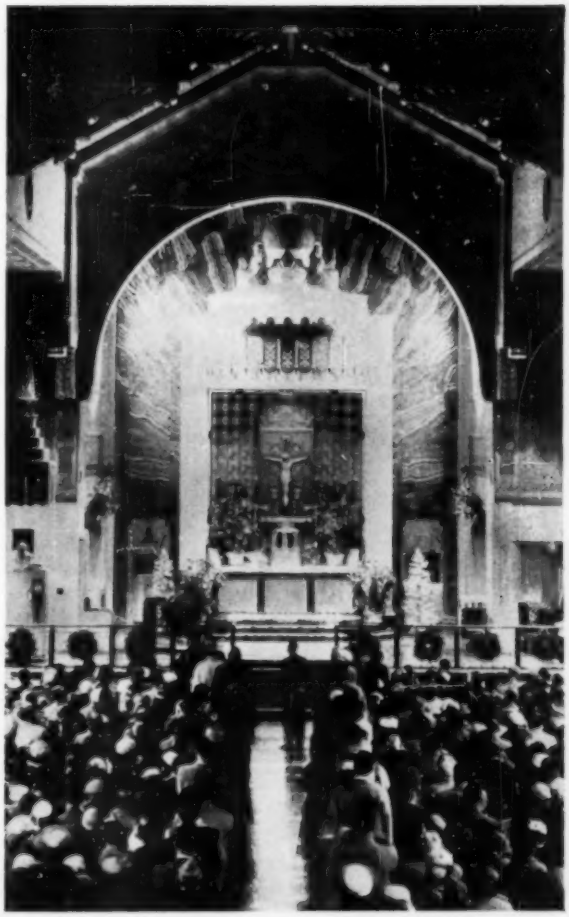

Unretouched black & white photo from N. Y. Sunday News Magazine Color Photo of Christmas Day Mass, 1955 at St. Andrew Avellino Church, Flushing, N. Y.

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ROOM COLORS: *3 walls—light green—60% R. F. Floor—15% R. F.*

Item No.	No. of 8' Lamps & W. A.	Total Lamp Watts	Foot-Candles With GrateLites	Foot-Candles Less GrateLites	Eff. With GrateLites	Eff. Without GrateLites	Brightness At 30° F. L.*	Brightness At 30° C.P./Sq. In.	Brightness At 45° F. L.*	Brightness At 45° C.P./Sq. In.
1	8 @ 300	480 W	28	22	70%	55%	80	0.27	110	0.37
2	16 @ 300	960 W	56	44	70%	55%	170	0.57	230	0.77
3	24 @ 300	1380 W	85	69	70%	56%	250	0.83	340	1.13
4	24 @ 430	1800 W	115	110	70%	65%	335	1.12	460	1.54
5	8 @ 300 24 @ 430	2280 W	143	137	65%	60%	420	1.40	580	1.93
6	16 @ 300 24 @ 430	2760 W	173	160	65%	58%	500	1.67	690	2.30
7	24 @ 300 24 @ 430	3240 W	202	180	64%	56%	590	1.97	810	2.70
8	40 @ 430	3440 W	240	215	70%	63%	700	2.34	960	3.20
9	8 @ 300 40 @ 430	4040 W	265	240	70%	63%	775	2.59	1060	3.54
10	16 @ 300 40 @ 430	4520 W	305	280	70%	63%	870	2.90	1200	4.00
11	24 @ 300 40 @ 430	4800 W	340	300	70%	62%	960	3.21	1320	4.40

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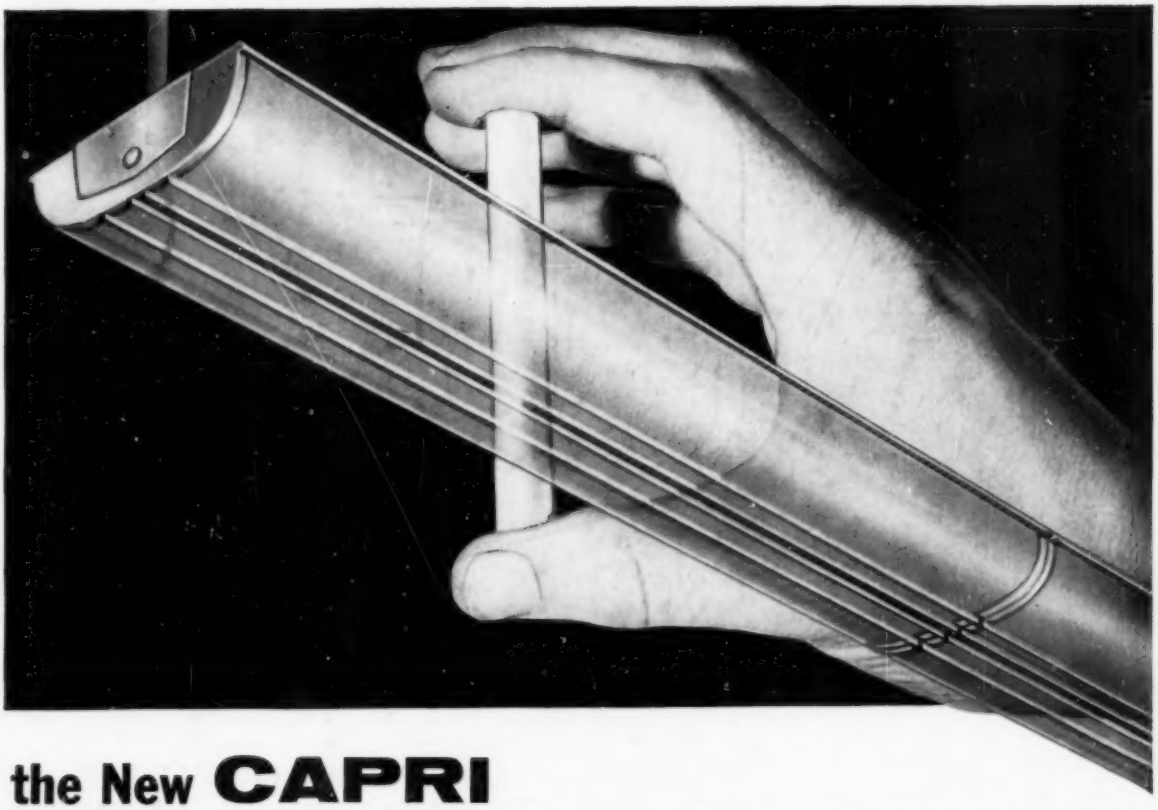

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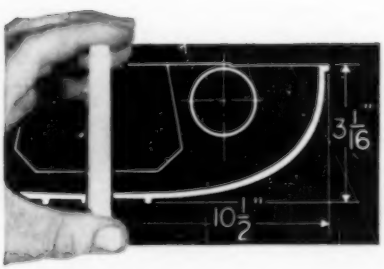

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